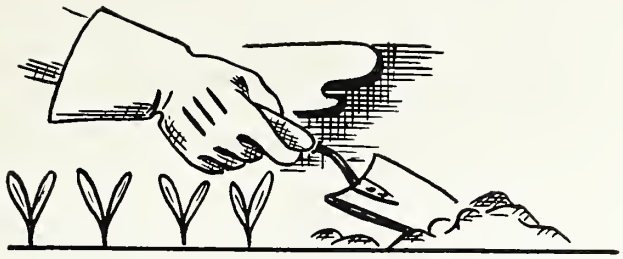
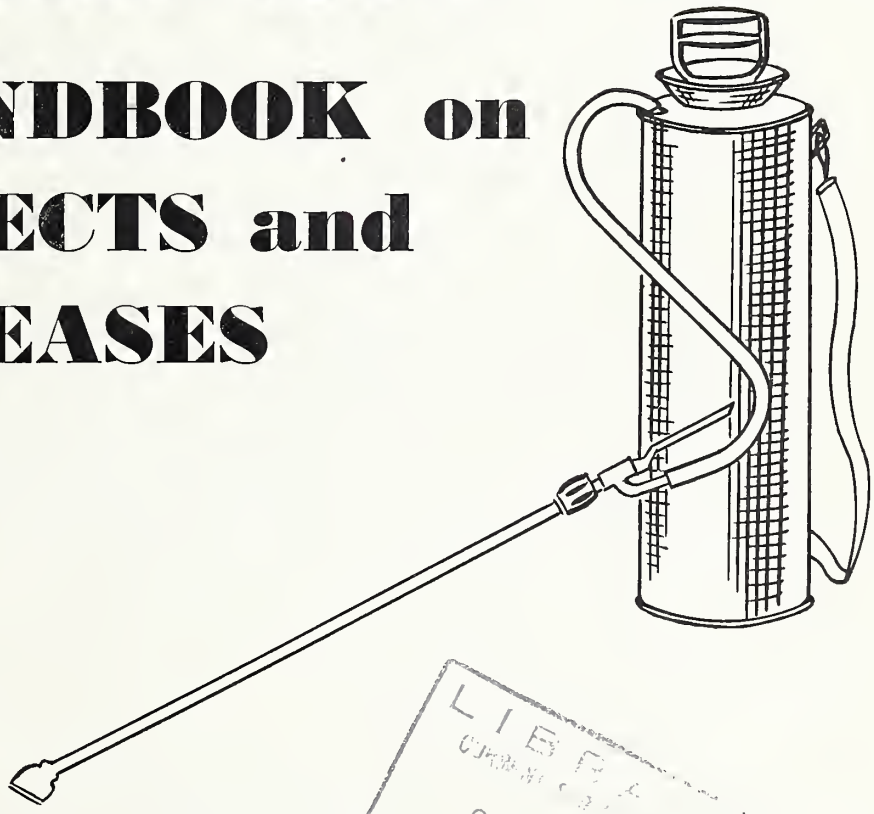
Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



VEGETABLE GARDENERS' HANDBOOK on INSECTS and DISEASES



LIBRARY
OCT 31 1951
U.S. DEPARTMENT OF AGRICULTURE

Miscellaneous
Publication
No. 605

UNITED STATES DEPARTMENT OF AGRICULTURE

THIS PUBLICATION has been prepared to aid the gardener in identifying the more common insects and related forms and the more common diseases that attack vegetable gardens in the United States and to provide him with simple directions for the control of these pests.

In the space available in this publication it is impossible to give detailed recommendations for the control of the insects and diseases listed or to include information on additional insects and diseases which may be found locally in vegetable gardens in various parts of the country. An attempt has been made, moreover, to simplify the directions for the preparation and application of the insecticides and fungicides recommended. For this reason the sprays, dusts, solutions, and baits have been reduced to a minimum and made as uniform as possible, even though in some instances the directions given herein for the preparation of the small quantities of materials usually needed for vegetable gardens may not conform exactly to the directions in the more detailed publications of the Department.

The formulas and directions for preparing the insecticides and fungicides will be found on pages 24–28 of this publication.

For more detailed information regarding the identity and control of insects and diseases affecting vegetable gardens the grower should consult experienced local gardeners or write to the county agricultural agent, State agricultural college, State department of agriculture, extension service, or the United States Department of Agriculture. When writing for information on pest control it is important to send specimens of the disease or insect which will identify the trouble. so that the proper recommendations for control can be made.

This publication is a revision of and supersedes Miscellaneous Publication No. 525, A Victory Gardener's Handbook on Insects and Diseases, which was issued in February 1944 and slightly revised in July 1944.

Washington, D. C.

Issued May 1946
Revised September 1951

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 20 cents

UNITED STATES DEPARTMENT OF AGRICULTURE

Miscellaneous Publication No. 605

Washington, D. C., May 1946
Revised September 1951

VEGETABLE GARDENERS' HANDBOOK ON INSECTS AND DISEASES

By W. H. WHITE,[1] *principal entomologist, Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine,* and S. P. DOOLITTLE, *senior pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration*

CONTENTS

	Page
Necessity of pest control by the vegetable gardener	1
Precautions to be taken with insecticides and fungicides	1
Warning regarding poison residues	1
Where to get insecticides and fungicides	1
Insects and diseases—description, damage, distribution, and remedies	2
General methods of insect and disease control	24
How to prepare insecticides and fungicides for garden-pest control	24
Tables of measures	28
Quantity of sprays or dusts to apply	29
Spraying and dusting equipment	29

NECESSITY OF PEST CONTROL BY THE VEGETABLE GARDENER

The control of the insects and diseases that affect vegetable crops is essential to the successful production of the farm, suburban, city, and community gardens that are being planted each year.

Regardless of the care and skill shown in the selection of a garden site, in the cultivation and fertilization of the soil, and in the selection and planting of seeds or transplants, all such efforts, involving the use of seeds, fertilizers, and tools, may be partially or completely nullified by depredations of insects and diseases unless steps are taken to control them.

PRECAUTIONS TO BE TAKEN WITH INSECTICIDES AND FUNGICIDES

In handling, mixing, and applying poisonous insecticides and fungicides, take special care not to inhale excessive quantities at any time. After working with insecticides, wash the hands or any exposed parts of the body thoroughly.

Containers in which these materials are kept or stored should be plainly labeled and placed under lock and key, or at least out of the reach of irresponsible persons or children. Any unused portions of these poisonous preparations as well as the receptacles in which they have been mixed should be treated likewise.

Experience and careful observation have shown that if the poisoned baits mentioned herein are prepared and applied according to directions, their use will not be hazardous to domestic animals, poultry, or wildlife.

WARNING REGARDING POISON RESIDUES

Unless the poison residues can and will be removed by washing or stripping, do not apply to the crop any spray, dust, solution, or bait that contains such materials as paris green, calcium arsenate, cryolite, sodium fluosilicate, chlordane, corrosive sublimate, calomel, or DDT, when foliage or fruit that is intended to be eaten is on the plants.

Apply all insecticides or other chemicals as sparingly as is consistent with the control of the insect or the disease that is being combated. When dusting or spraying make every effort to apply a light, even coating. Avoid unnecessarily heavy applications.

WHERE TO GET INSECTICIDES AND FUNGICIDES

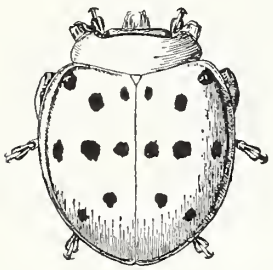
Information regarding the purchase of the insecticide and fungicide materials may be obtained through experienced local gardeners, local dealers in agricultural supplies, and seedsmen; or through the county agricultural agent, State agricultural college, State department of agriculture, extension service, or the United States Department of Agriculture.

[1] Died on March 14, 1951.

ASPARAGUS

	Insect or Disease	Remedy
5 times natural size.	**Asparagus beetle:** Metallic blue to black, ¼ inch long. Orange to yellow markings. Larvae olive-colored and humped, ⅓ inch long. Adults and larvae feed on full-grown plants, and early shoots may be gnawed at and disfigured. May be a pest wherever asparagus is grown except in California.	*When edible shoots are infested,* use rotenone (dust mixture 18, p. 25, or spray mixture 5, p. 25). *After cutting for the season has been completed,* use calcium arsenate (dust mixture 14, p. 25, or spray mixture 1, p. 25). *Shoots intended for eating should not be poisoned with calcium arsenate.* See warning regarding residues on page 1.
	Rust (fungus): Elongated, orange-red, powdery pustules on stems and foliage; turning dark in fall. Tops die early and next year's crop is reduced. Most serious in moist seasons. Common wherever asparagus is grown.	Plant rust-resistant varieties, Mary Washington or Martha Washington. Use seed of a dependable strain whose resistance has been maintained. Cut tops close to ground in fall and burn them.

BEANS

 5 times natural size.	**Mexican bean beetle:** Adult copper colored with 16 black spots on back. Oval shape, ¼ inch long. Larvae orange to yellow and fuzzy. Lower surface of leaf eaten between veins, appearing skeletonized. Pods also damaged. Occurs in most of the States east of the Rocky Mountains.	Spray under sides of leaves with rotenone (spray mixture 5, p. 25), or dust with rotenone (dust mixture 18, p. 25) every 10 days. Cryolite (spray mixture 2, p. 25, or dust mixture 15, p. 25) may be used until the pods begin to form. Hand picking of beetles and crushing of egg masses is effective if done often. *Do not use lead arsenate or paris green on beans, as either of these will injure the plant.* See warning regarding residues on page 1.
5 times natural size.	**Bean leaf beetle:** Adult reddish to yellowish, with 4 black spots on back. Regular-shaped holes eaten in leaves. Occurs in all eastern States, but damage is usually restricted to small areas.	Same as for Mexican bean beetle. See warning regarding residues on page 1.
5 times natural size.	**Spotted cucumber beetle:** Adults about ¼ inch long, yellow-green with 12 spots on back. Holes eaten in leaves. Pods also damaged. Beans grown east of the Rocky Mountains subject to some damage each year. Another closely related species damages beans in California, Washington, and Oregon.	Same as above.
10 times natural size.	**Leafhoppers** (cause hopperburn): Adults small, green, active, wedge-shaped, in some localities called "white flies." Tips of leaves become dry and brown. Occurs east of the Rocky Mountains. Damages beans in the Southern and Eastern States.	Dust under sides of leaves with DDT (dust mixture 16, p. 25) or sulfur-pyrethrum (dust mixture 21, p. 26) or spray with DDT (spray mixture 3, p. 25). See warning regarding residues on page 1.

Insect or Disease	Remedy
5 times natural size. **Seed-corn maggot:** Legless white maggot similar to cabbage maggot. Bores into sprouting seed and prevents development of the plant. Damage may occur in any section of the United States; particularly destructive in the Eastern States in the early part of the season.	As soon as maggot injury is discovered, replant. Avoid organic fertilizer in seeded row. Partially decayed vegetable matter attracts the flies, and lands containing such material are likely to become infested with maggots which will attack germinating seed. Plant seed shallow in such lands, and prepare seedbed so as to promote rapid germination; plant seed when the soil is warm. Cool, wet periods retard seed germination and promote maggot injury.
5 times natural size. **Aphids** (plant lice): Small black insects clustered on stems and under leaves. Leaves curl and thicken, and plants become yellowed and have unthrifty appearance. Occurs over the United States. Damage is of local character.	Dust with nicotine dust (dust mixture 17, p. 25) or spray with nicotine sulfate (spray mixture 4, p. 25). Dust or spray with nicotine only when temperature is 65° F. or above. Soap spray (spray mixture 12, p. 26) is fairly effective.
40 times natural size. **Red spiders:** Very small, red or greenish-red mites on under side of leaves. Injured leaves turn yellow, and plants are stunted. Occurs all over the United States but is most likely to cause damage under dry, hot conditions.	Dust with sulfur.
Seed decay (fungus): Most common in cool, moist weather.	Treatment is most important for lima beans. Treat seed with Arasan or Spergon (p. 27). Do not use Semesan on lima beans.
Anthracnose (fungus): Pods show round, sunken spots with dark, reddish-brown borders and pink centers. Elongated, dark-red cankers on stems and leaf veins. Ripe seeds show rusty-brown spots. Fungus carried in seed. Most common in cool, moist summers. May occur in the Central, Northeastern, and Southeastern States.	Do not save seed from spotted pods or plant seed showing any discoloration. Do not work in garden when plants are wet. Use western-grown seed.
Bacterial blights: Leaves show large, dry, brown spots with yellow borders. Reddish cankers on stem, which may cause girdling. Water-soaked spots with reddish margins on pods. May occur wherever beans are grown but seldom found in most Intermountain and Pacific Coast States.	Same as for anthracnose. Seed from far western States is largely free from blight.
Rust (fungus): Appears chiefly on leaves as red pustules which become black late in the season and cause defoliation. May occur in most regions where beans are grown, except in a few semiarid sections.	Spraying with wettable sulfurs or bordeaux mixture, or dusting of plants with sulfur may be effective. The following snap bean varieties are fairly tolerant: Stringless Black Valentine, Landreth Stringless Green Pod, Tendergreen, Pencil Pod Black Wax, Round Pod Kidney Wax, Rust Resistant Kentucky Wonder (pole).
Mosaic (virus): Mottling of leaves in light- and dark-green areas, accompanied by more or less curling and stunting of foliage and reduction in yield. Carried in seed and where once introduced spread by plant lice. Common throughout United States.	The varieties Idaho Refugee, U. S. No. 5 Refugee, Sensation Refugee, Topcrop, Rival, Logan, Contender. Tenderlong No. 15, Idagreen, Ranger, and Kentucky Wonder (pole) are mosaic-resistant.

BEETS

15 times natural size.

About natural size.

Insect or Disease	Remedy
Flea beetles: Small, black, or striped; jump like fleas. Small holes eaten in leaves of seedling plants. Several species may cause damage wherever beets are grown.	Dust with rotenone (dust mixture 18, p. 25). or spray with rotenone (spray mixture 5 p. 25).
Beet webworm: Larvae greenish-white to dark-brown caterpillars. Leaves and buds of young, tender plants eaten. Feeding surfaces often covered with webs. Occurs quite generally and may be especially troublesome in the Western States.	Dust with pyrethrum (dust mixture 19, p. 25).
Damping-off (fungus): Decay of seed in soil and death of young seedlings.	Treat seed with Arasan, Spergon, or Semesan (p. 27).
Leaf spot (fungus): Leaves show numerous small, round, dead spots with white centers and purple borders. Common in most of United States.	Usually leaf spot is not severe enough to require treatment. Spraying with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or preparations of ziram, zineb, or nabam (p. 28), will help to control the disease. Dusts containing copper, ziram, or zineb may be used.

BROCCOLI AND BRUSSELS SPROUTS

Aphids (plant lice): Small, green, sucking insects clustered on under side of leaves or on stems. See illustration under Beans. Leaves curled; plants yellowed.	Same as for bean aphid.
Caterpillars (cabbage worms): See Cabbage.	See Cabbage. See warning regarding residues on page **1.**
Flea beetles: See Cabbage.	See Cabbage.
Aphids, caterpillars, and flea beetles damage broccoli and brussels sprouts wherever these crops are grown.	
Damping-off, clubroot, black rot, blackleg: See Cabbage.	See Cabbage for methods of control.

CABBAGE

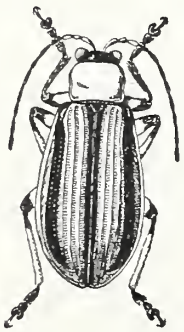
Cabbage caterpillars: Larvae, green or striped caterpillars on leaves or head. Three different caterpillars are illustrated at the left. The one at the top is the imported cabbage worm, which is recognized by its velvety skin. In the middle is the cabbage looper shown in a characteristic pose. At the bottom is shown the caterpillar of the diamondback moth on a piece of a leaf which it has been eating. A small area of the lower leaf surface has been eaten, and the caterpillar is often found in or near this spot. If disturbed it will wriggle vigorously and drop from the leaf, hanging to it, however, by a slender thread of silk. All three caterpillars are drawn slightly less than natural size. Holes eaten in leaves. Damage cabbage wherever grown.	*Before the heads or parts that are to be eaten begin to form:* Dust with DDT (dust mixture 16, p. 25) or spray with DDT (spray mixture 3, p. 25). *After the heads or parts that are to be eaten begin to form:* Apply a rotenone dust mixture (dust mixture 18, p. 25) or a rotenone spray (spray mixture 5, p. 25) or a pyrethrum dust (dust mixture 19, p. 25) or a pyrethrum spray (spray mixture 6 p. 25). If diamond-back moth caterpillars are abundant, use rotenone dusts or sprays rather than pyrethrum. See warning regarding residues on page 1.

Insect or Disease	Remedy
3 times natural size. **Harlequin bug:** Shield shaped; black, brilliantly colored with red or yellow, about ⅜ inch long. Plants wilt, turn brown as if scalded. Damage usually local in nature; but pest occurs in the southern part of the country in damaging numbers from California to Virginia.	Hand-pick bugs and egg masses. Dust with 10- to 20-percent sabadilla powder.
Cabbage aphid: Small, green to powdery blue, soft-bodied aphids, clustering on leaves. See illustration under Beans. Leaves curl and become distorted. Plants stunted.	Same as for bean aphid.
Flea beetles: Small, black or striped beetles; jump like fleas. See flea beetles on beets for a picture of one of these insects. Small holes eaten in leaves. Especially damaging to young plants. The cabbage aphid and flea beetles occur wherever cabbages are grown, and damage is of a local nature.	Dust with DDT (dust mixture 16, p. 25), or spray with DDT (spray mixture 3, p. 25), until heads or parts that are to be eaten begin to form. After this stage use rotenone dust (dust mixture 18, p. 25) or rotenone spray (spray mixture 5, p. 25). See warning regarding residues on page 1.
5 times natural size. **Cabbage maggot:** Legless, white maggots ¼ to ⅓ inch long. Larvae, or worms, tunnel roots causing rot; plants wilt. Particularly destructive in seedbeds and to young plants after setting in the field. Occurs over a wide area in the northern part of the country from Minnesota eastward. Damage probably more severe in the Northeastern States than elsewhere.	Corrosive sublimate solution (bichloride of mercury) or calomel (solution 13, p. 26). Pour ½ cupful of solution on soil at base of each plant soon after setting and 10–12 days later. In seedbed, or for plants in rows, apply at base of plants at rate of 1 gallon per 35 feet of row. A tar-felt or light roofing paper disk placed around the base of the stem of each plant will aid in maggot control. Such a disk should be about 3 inches in diameter, fitted snugly around the stem. This disk should be put in place immediately after the setting of the plants in the garden (fig. 10, p. 30). See caution regarding use of poisons on page 1.
Damping-off (fungus): Decay of seed in soil and collapse and death of young seedlings.	Treat seed with Spergon, Arasan, or Semesan (p. 27). *Do not use cuprous oxide.*
Clubroot (slime mold): The slime mold enters roots and produces large, irregular swellings and malformations. Plants are sickly and stunted. Attacks plants both in seedbed and field and affects other cultivated plants of cabbage family. Occurs throughout the United States.	Do not attempt to grow cabbage or related plants in soil where disease has been severe. Grow seedlings in clean soil. Do not use plants showing slight swellings on roots. Rotate crop in garden. Where soil is not severely infested the use of a 1:1,500 solution of corrosive sublimate for watering the plants at time of transplanting may be helpful (p. 27).
Root knot (eelworm or nematode): Smaller swellings on roots than with clubroot; more evenly distributed over feeding roots. If swellings are broken open they show pearly-white specks which are egg-bearing nematodes. Affects other plants in garden, while clubroot is found only on cabbage, brussels sprouts, cauliflower, and other plants of the cabbage group. Most common in Southern States.	Do not plant cabbage where root knot has been found on roots of plants. Endeavor to use new land if present garden soil is infested with root knot organisms. Grow seedlings in nematode-free soil. Burn all infested roots.

CABBAGE—Continued

Insect or Disease	Remedy
Yellows, or wilt (fungus): Plants are stunted, yellowish-green; lower leaves drop. Plants often have a one-sided appearance and those that live through the season rarely make good heads. Fungus lives in the soil and enters plant through roots. Affects cabbage, kohlrabi, and kale severely; cauliflower, broccoli, and brussels sprouts are resistant. May occur wherever cabbage is grown.	Start seed in clean soil and never set diseased plants. Spraying is of no value, Where yellows occurs, use resistant varieties, such as Jersey Queen, Resistant Detroit, Marion Market, Globe, Wisconsin Ballhead, or Wisconsin All-Season.
Black rot (bacterial): Leaves yellowed at edges, with blackened veins, and may drop from plants. Stems show a blackened ring when cut across. Plants often die or may not form heads. Also affects other members of cabbage group, particularly cauliflower. Bacteria are carried in seed and live in the soil. Common in the Central, Southern, and Eastern States.	Plant seed in soil that has not grown cabbage. Seed from Pacific Coast regions is free from black rot.
Blackleg (fungus): Seedlings show ashen-gray spots on leaves and stems. These spots are covered with tiny black dots characteristic of the disease. Stems may be girdled and plants may wilt and die when small or break over after heads are formed. Fungus is carried in seed and lives on crop refuse in soil. Affects all plants of the cabbage family. Common in the Central, Eastern, and Southern States.	Use same methods as recommended for black rot.

CANTALOUP OR MUSKMELON

Aphids (plant lice): Small, green to black, soft-bodied insects; clustered on under side of leaves. See illustration under Beans. Leaves curled, distorted, yellowed; plants stunted. Plant lice occur wherever melons are grown, but are more likely to be destructive in the southern part of the country than elsewhere.	Same as for aphids on beans. Destroy or cover heavily infested plants with soil to prevent spread. *Do not use sulfur on cantaloup or muskmelon plants.*
 6 times natural size. **Striped cucumber beetle:** Yellow and black beetle ⅛ inch long; 3 black stripes down back. The worm, or larva, is ⅓ inch long, slender, and white, brownish at ends. Young plants attacked, followed by wilting; holes eaten in leaves. Larva bores into or feeds on roots and on stems at and below the soil line. Occurs generally over the country east of the Rocky Mountains. Another species damages melons in the Western States.	Dust with cryolite (dust mixture 15, p. 25) or rotenone (dust mixture 18, p. 25), or dust with a mixture of 1 pound of calcium arsenate and 15 pounds of gypsum (land plaster) once or twice a week. See warning regarding residues on page 1.
Spotted cucumber beetle: Yellow-green beetle with 12 black spots on the back. See under Beans for a picture of the spotted cucumber beetle. Young plants attacked; holes eaten in the leaves. Occurs wherever melons are grown east of the Rocky Mountains. Another species injures melons on the West coast. Damage of a local nature.	Same as above.

CANTALOUP OR MUSKMELON—Continued

Insect or Disease	Remedy
Nearly twice natural size. **Melon worm** and **pickleworm:** Whitish to greenish worms up to ¾ inch long, with brownish heads. Foliage and buds attacked; worms feed in the fruit. Presence shown by small holes usually on under side of melon. The two worms are particularly destructive in the Southern States and the pickleworm may damage late melons as far north as New York and into the Central States.	*Before fruits form*: Dust growing tips and blossoms with cryolite (dust mixture 15, p. 25) once a week, beginning when worms are first found. *After fruits form:* Dust with rotenone (dust mixture 18, p. 25). See warning regarding residues on page 1.
Damping-off (fungus): Decay of seed in soil and collapse and death of young seedlings.	Treat seed with Arasan, Spergon, or Semesan (p. 27).
Anthracnose (fungus): Reddish-brown, roughly circular spots on leaves; elongated, tan-colored cankers on stems. Green fruits show round, sunken spots with pinkish-tan centers, turning dark later. Fungus carried on seed and lives in soil. Worst in warm, moist weather. Also attacks cucumber and watermelons. Common in the Central, Eastern, and Southern States.	Treat seed with 1:1,000 corrosive sublimate (p. 27). Do not grow cucumbers or melons on same land oftener than once every 3 years. Spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or organic fungicides (p. 28). Copper (p. 28) or organic fungicide (p. 28) dusts can be used.
Downy mildew (fungus): Yellowish, somewhat irregular spots on leaves; followed by drying, curling, and death of older foliage. Fruit not affected. Not carried on seed. Attacks cucumbers. Often destructive in Southern and Atlantic Coast States.	Spraying or dusting as for anthracnose may keep plants alive for 2 to 3 weeks longer than unsprayed plants, but foliage must be well coated on under surface.
Bacterial wilt: Vines gradually wilt and die. Young plants are soon killed, but older vines at first may have only one shoot affected. No yellowing of leaves. Caused by bacteria entering and plugging water vessels of stem and leaves. Bacteria are not carried on seed or in soil but are spread by cucumber beetles, in which they also live over the winter. Attacks cucumber and squash. Common in North-Central, and Northeastern States.	Pull and burn all wilted plants found early in season. Follow recommendations for control of cucumber beetles given on page 6.
Leaf spot (fungus): Numerous small, round, dead spots on leaves; no spotting of fruit. Leaves may be killed. Common on muskmelon and occurs on cucumber. Common in Central, Southern, and Atlantic States.	See recommendations for control of anthracnose.
Mosaic (virus): Leaves mottled with greenish-yellow. Plants may be stunted; fruit of poor quality. East of the Mississippi mosaic generally is caused by the cucumber mosaic virus that is not carried in seed. Other forms of virus that are seed-borne attack cantaloups in the West. None of the viruses are carried in soil. They live over in perennial weeds and are carried from weeds to cultivated crops by plant lice. May occur wherever vine crops are grown.	Destroy all perennial weeds near garden. The cucumber mosaic virus infects milkweed, groundcherry, catnip, and other perennial weeds. Plant lice carry it from weeds to the garden. If mosaic appears on young cantaloups they should be destroyed. Cucumbers, squash, peppers, celery, and tomatoes are susceptible to cucumber mosaic. Western forms of virus also have perennial hosts and infect cucumbers, squash, and other crops.

CARROTS

Slightly less than natural size. **Carrot caterpillar:** Large worm up to 2 inches long, green, banded with black and yellow markings. Leaves eaten; tops destroyed. Widely distributed but only occasionally becomes numerous enough to cause damage.	Hand-pick.

CARROTS—Continued

4 times natural size.

Insect or Disease	Remedy
Carrot rust fly: ⅛ inch long; yellowish white, legless maggot. Destruction of fibrous roots; tunneling in fleshy roots. Damage is caused by the rust fly in the coastal areas of Washington and Oregon, and in Michigan, northern Ohio, Pennsylvania, New Jersey, New York, Massachusetts, Connecticut, Vermont, New Hampshire, and Maine.	Apply naphthalene or a mixture of calomel with water. The success of the remedy depends upon timeliness of treatment. Consult your local entomologist.
Leaf blight (fungus): Black or brown spotting of leaves and leaf stalks followed by drying and death of older foliage. Occurs in most sections where carrots are grown.	Rotate crop in garden. If disease is commonly destructive, spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or organic fungicides (p. 28). Copper (p. 28) or organic fungicide (p. 28) dusts can be used. Spraying or dusting generally is unnecessary.

CAULIFLOWER

Aphids (plant lice): See cabbage aphid.	Same as for cabbage aphid.
Caterpillars: Larvae, green or striped worms on leaves or head. See under Cabbage for pictures of some of these caterpillars. Holes eaten in leaves. Aphids and caterpillars damage cauliflower wherever it is grown in the United States.	Same as for caterpillars on cabbage.
Damping-off, clubroot, black rot, black leg: (See Cabbage).	Same as for cabbage.

CELERY

Twice natural size.

Celery leaf tier: Small, greenish caterpillar that webs the leaves. Webbing of leaves and hole in stalk. Damage to celery sometimes serious in Florida and California and in northern celery-growing areas.	Dust with pyrethrum (dust mixture 19, p. 25). Repeat in ½ hour.
Early blight (fungus): Small circular, yellowish-brown spots on older leaves that enlarge and turn dark, later changing to ashen gray. Leaf stalks are affected. Fungus lives over in the soil and is spread by rain. Common in most celery-growing regions.	Spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or organic fungicides containing zineb, nabam (used with zinc sulfate and lime), or ziram (p. 28), or use dusts containing copper (p. 28), zineb, or ziram (p. 28). Destroy plant refuse in fall and rotate crop.
Late blight (fungus): Small, yellow spots on older leaves and leaf stalks, later turning almost black. Spots covered with minute black dots, which distinguish it from early blight. Fungus carried on seed. Occurs in most celery-growing regions.	Same as for early blight, but where disease is common spraying should begin in seedbed. Rotate crop and destroy plant refuse in fall.
Pink rot (fungus): Watery spots at base of older plants, followed by white, cottony fungus growth which develops a pink color. Stalks are rotted and have bitter taste. Fungus, which also attacks cabbage and lettuce, lives over for years in soil. Most common in Southern States but occurs in North-Central and Northeastern States.	Avoid planting celery, lettuce, or cabbage in immediate succession on same soil. Remove and burn infected plants.
Yellows (fungus): Stunting, yellowing, and sometimes death of plant. Fungus lives for years in soil and attacks plant through roots. Most common in Central and Eastern States.	Avoid infected soil if possible. Use yellows-resistant varieties such as Michigan Golden, Florida Golden, or Forbes Golden Plume, if self-blanching varieties are desired. Green celeries are generally resistant.

CHARD

Insect or Disease	Remedy
Flea beetles: See Beet.	Dust with rotenone (dust mixture 18, p. 25), or spray with rotenone (spray mixture 5, p. 25).
Leaf spot (fungus): See Beet.	Same as for beet.

COLLARDS

Aphids: See cabbage aphid.	Same as for bean aphid.
Caterpillars: See Cabbage.	Same as for caterpillars on cabbage.
Flee beetles: See Cabbage.	Same as for flea beetles on cabbage.
Harlequin bug: See Cabbage.	Same as for harlequin bug on cabbage.
Clubroot, black rot, yellows, blackleg: See Cabbage.	Same as for cabbage.

CORN—See Sweet Corn

CUCUMBER

See Cantaloup for insects.

Do not use sulfur on cucumber plants.

Damping-off, anthracnose, downy mildew, bacterial wilt, leaf spot: See Cantaloup.

Same as for cantaloup. The varieties Palmetto and Santee are resistant to downy mildew.

Scab (fungus): Fruits show sunken, dark-brown spots with a gummy exudate. In moist weather these may be covered with a grayish-olive growth of the fungus. Some spotting of leaves and stems. Worst in cool, moist weather. Occurs chiefly in Northeastern and North Central States.

Spray or dust as recommended for cantaloup anthracnose. Varieties Highmoor and Maine No. 2 are resistant.

Mosaic (virus): Leaves mottled with yellow spots, curled, and dwarfed. Fruits mottled with yellow, misshapen and warty. Infected plants of little value. Not carried in seed or soil. Lives over in perennial weed hosts. Spread by plant lice and cucumber beetle.
Common throughout the United States.

Same as for cantaloup. The varieties Shamrock, Burpee Hybrid, Early Sure Crop Hybrid, and York State Pickling are resistant to mosaic.

EGGPLANT

3 times natural size.

Colorado potato beetle: See Potato.

Before fruits begin to form: Dust or spray with DDT (dust mixture 16 or spray mixture 3, p. 25).
After fruits form: Use rotenone dust (dust mixture 18, p. 25) or rotenone spray (spray mixture 5, p. 25).
See warning regarding residues on page 1.

Flea beetles: Black or brown jumping beetles, 1/16 inch long. See flea beetles on beets for a picture of one of these insects.
Small holes eaten in the leaves. Young plants suffer the most from attacks of these pests and become stunted.
Damage occurs in most of the areas where eggplant is grown.

Same as for Colorado potato beetle.
See warning regarding residues on page 1.

About 1/3 natural size.

Hornworms: Large, green worms with diagonal lines on sides, with prominent horn at rear end.
Eat foliage and fruit.
Widely distributed but only occasionally damages eggplant.

Hand-pick.

EGGPLANT—Continued

Insect or Disease	Remedy
Aphids: Green, soft-bodied insects; clustered on leaves. Leaves curled and distorted; plants yellowed. Widely distributed and in some seasons may cause serious damage.	Same as for bean aphid.
Damping-off (fungus): Seeds decay and young seedlings fall over and die.	Treat seed with Arasan, Spergon, or Semesan (p. 27).
Fruit rot (fungus): Attacks plants at any stage. Stem often affected at ground line, becoming brown and shrunken. Brown or gray spots on leaves; leaves may die. Large, ringed, circular, tan or brown spots on fruit; covered with small pustules. Carried in seed and soil. Common throughout United States.	Save seed from sound fruit or treat seed with 1:1,000 corrosive sublimate for 10 minutes (p. 27). Rotate crop in garden.
Wilt diseases (fungi): Gradual wilting, stunting, and occasionally death of plant. Occur wherever eggplant is grown.	Avoid land that has recently grown tomatoes or potatoes. Rotate crop.

KALE AND KOHLRABI

Aphids: See Cabbage aphid.	Same as for bean aphid.
Caterpillars: See Cabbage.	Same as for caterpillars on cabbage.
Flea beetles: See Cabbage.	Same as for flea beetles on cabbage.
Harlequin bug: See Cabbage.	Same as for harlequin bug on cabbage.
Clubroot, black rot, yellows, and **blackleg:** See Cabbage.	Same as for cabbage.

LETTUCE

Aphids: Green, soft-bodied insects; clustered on leaves. Generally similar to the aphids found on beans. See illustration there. Leaves curled and distorted. Widely distributed and in some seasons may cause damage in garden areas.	Same as for aphids on beans.
Slightly less than natural size. **Loopers:** Green measuring worms. Ragged holes eaten in leaves. Widely distributed but only occasionally damage lettuce in most localities. May be particularly destructive in Florida, California, and Arizona.	Dust with rotenone (dust mixture 18, p. 25) or pyrethrum (dust mixture 19, p. 25).
Drop (fungus): Wilting of outer leaves followed by rapid wilting and decay of entire plant; watery soft rot of stem and older leaves; worst in moist weather. Common in the Central, Eastern, and Southern States.	Avoid too close planting and poorly drained soil. Ridge soil about plants slightly to prevent water standing about stems.
Yellows (virus): Yellowing, blanching, curling, and twisting of inner leaves. Abnormal production of small shoots. Affects various plants of lettuce family and many other wild and cultivated plants. Spread by leafhoppers. Occurs throughout United States.	No particularly effective control is known.
Tipburn (physiologic): Under adverse temperature conditions the margins of the most rapidly growing leaves turn brown and dry. Occurs wherever lettuce is grown.	Most serious on head lettuce. Varieties Great Lakes, Cornell 456, and Pennlake are resistant.

MUSTARD—See Turnip

ONIONS

Insect or Disease	Remedy
25 times natural size. **Thrips:** Very tiny, active, yellow insects, 1/25 inch long. Whitish blotches on leaves; tips of leaves wither and turn brown. Widely distributed; causes some damage nearly every season.	Dust with 10-percent DDT dust or spray with 4 level tablespoonfuls of 50-percent DDT wettable powder per gallon of water. *If the tops are to be eaten,* spray with nicotine sulfate (spray mixture 4, p. 25) or soap (spray mixture 12, p. 26). See warning regarding residues on page 1.
Onion maggot: Small, white worm, 1/3 inch long. Similar in size and appearance to cabbage maggot. Burrows into onion bulbs. This insect is not known as a pest in California or in the southern half of the United States; it is a major pest of onions in some of the North-Central and Northeastern States.	Treat with corrosive sublimate or calomel as outlined under Cabbage maggot, page 5.
Smut (fungus): Causes blisters full of black, powdery masses of fungus on leaves of young plants, often killing them. Fungus lives over in soil where disease has occurred. Most common onion disease in the Northern States but does not cause loss in the Southern or Southwestern States.	Avoid soil where smut has been found on previous crops. If this cannot be done, sprinkle formaldehyde solution (1 teaspoonful to 1 quart of water) in drill where seeds have been dropped, before covering them. Use 3 quarts of solution to 100 feet of row.

OKRA

Aphids: Green to black, soft-bodied insects; clustered on under side of leaves. See illustration under Beans. Leaves curled and distorted; plants stunted. Damage may occur wherever okra is grown.	Same as for aphids on beans.
A little less than natural size. **Corn earworm:** Green or brownish worm, up to 1¾ inches long with light stripes. Holes eaten in pods. Damage often minor but may occur wherever okra is grown.	Hand-pick and destroy damaged pods and worms.
Root knot (eelworm or nematode): Gall-like swellings on roots and some stunting of plants. Occurs commonly in the Southern and Southwestern States.	Avoid planting on soil badly infested with root knot; rotate garden plot where possible. Burn diseased roots.
Wilt (fungus): Yellowing and wilting of leaves and stunting of plants. Occurs in the Southern States, but is only occasionally serious.	Avoid land where disease has occurred and do not grow in same spot more than once in 3 years.

PARSNIP

Caterpillar: See Carrot.	Same as for carrot caterpillar.
Carrot rust fly: See Carrot.	Same as for cabbage maggot.

PEAS, GARDEN

Pea aphid: Pale-green plant lice clustered on leaves, buds, and pods. Similar in general appearance to the aphids found on beans. See illustration under Beans. Leaves turn yellow; plants stunted; pods misshapen. Damage may occur wherever garden peas are grown.	Dust with nicotine (dust mixture 17, p. 25) or rotenone (dust mixture 18, p. 25), or spray with nicotine (spray mixture 4, p. 25) or rotenone (spray mixture 5, p. 25). Soap spray (spray mixture 12, p. 26) fairly effective.

PEAS, GARDEN—Continued

Insect or Disease	Remedy
5 times natural size.	
Pea weevil: Parent weevil is brownish with white, black, and grayish markings, ⅛ inch long. Weevil grubs are white with small brown head and mouth, ⅓ inch long. Infested peas have cavities made by weevil grubs. Generally distributed, but damage is confined principally to Utah, Idaho, Washington, Oregon, New York, and Wisconsin.	Dust with rotenone (dust mixture 18, p. 25). Apply to pea plants in infested fields after blossoming begins and before the first tiny pods appear.
Seed-corn maggot: Legless white maggot similar in size and appearance to cabbage maggot. Bores into sprouting seed and prevents development of the plant. Damage may occur in any section of the United States; particularly destructive in the Eastern States in the early part of the season.	As soon as maggot injury is discovered, replant. Avoid organic fertilizer in seeded row. Partially decayed vegetable matter attracts the flies, and lands containing such material are likely to become infested with maggots which will attack germinating seed. Plant seed shallow in such lands, and prepare seedbed so as to promote rapid germination; plant seed when the soil is warm. Cool, wet periods retard seed germination and promote maggot injury.
Seed decay (fungus): Most common in cool, moist weather.	Treat seed with Spergon, Arasan, or Semesan (p. 27).
Ascochyta pod spot (fungus): Irregular, light-colored spots with dark margins on pods; concentric circular spots on leaves with tiny, dark dots in centers; stems also spotted near ground. Fungus carried on seed and lives on old vines. Most likely to occur in the Central, Southern, and Northeastern States.	Spraying of no value. Burn diseased vines after crop is picked. Seed grown in semiarid West is relatively disease-free.
Root rots (fungus): Plants do not grow vigorously; many turn yellow and may die at flowering time. Stems below ground and roots are decayed and yellowish brown, red, or black. Caused by soil-borne fungi. Occur wherever peas are grown.	Do not grow peas continuously on same soil. Use well-drained soils, since excessive soil moisture favors root rots.
Bacterial blight: Large, water-soaked spots on pods and irregular, dark spots on leaves. Cream-colored, shining ooze in centers of spots. Bacteria are carried on seed. Rather common in most localities where peas are grown but rare in semiarid regions of the West.	If possible, use seed grown in semiarid regions of the West. Spraying is of no value.
Fusarium wilt (fungus): Leaves are yellow and plants may wilt and die. Interior of stems colored lemon-yellow. Caused by soil-borne fungus which enters through the roots.	Spraying of no value. Among several resistant varieties are Alaska, Improved Gradus, Dwarf Alderman, Alderman, Teton, and Number 40.

PEAS, BLACK-EYE

5 times natural size	
Cowpea curculio: Black humpbacked beetle, ¼ inch long with long snout, which in the specimen illustrated is doubled back under the body. Small holes eaten in pods and developing black-eye peas. Damage to black-eye peas and cowpeas occurs in States east of the Mississippi River and south of Tennessee and Virginia.	Spray with cryolite (spray mixture 2, p. 25), or dust with cryolite (dust mixture 15, p. 25). Do not apply cryolite within 2 weeks before picking.
Seed-corn maggot: See Seed-corn maggot under Peas, Garden.	Same as on garden peas.

PEPPER

About ⅓ natural size.

Insect or Disease	Remedy
Hornworms: Large, green worms with diagonal lines on sides, with prominent horn on rear end. Eats foliage and fruit. Damage to peppers occurs only locally. Hornworms occur wherever peppers are grown.	Hand picking.
Damping-off (fungus): Decay of seed in soil and wilting and death of small seedlings.	Treat seed with Arasan, Spergon, or Semesan (p. 27).
Cercospora leaf spot (fungus): Fungus leaf spot causes circular, water-soaked spots which enlarge and become white in center; similar spots on stems. Caused by fungus which is carried on seed. Common in all but semiarid regions.	This disease is only occasionally destructive. Losses can be reduced by treating seed with a 1 : 2,000 solution of corrosive sublimate (p. 27) and planting in new seedbed soil. If the disease commonly occurs, spray with bordeaux mixture (spray mixture 8, p. 26) or fixed coppers (p. 27). Copper dusts (p. 28) can be used.
Bacterial leaf spot: Causes small, round, water-soaked spots on leaves, which may yellow and drop. Fruits show rough, scabby spots. Carried on seed. Occurs in all but semiarid regions.	Same as above.
Anthracnose (fungus): Most common on ripe fruits, producing large, dark-brown or black spots whose centers show tiny, black specks. Often follows sunscald of older green fruits. Common in Central, Southern, and Atlantic States.	Use clean seed and avoid continuous planting of peppers on the same soil.
Blossom-end rot (physiologic): Light-colored, sunken, watersoaked spots near blossom end of fruits; these spots enlarge until one-third of the fruit may be affected and become dark and shriveled; spots later may be overgrown by fungi. Occurs throughout the United States.	Avoid excessive use of nitrogenous fertilizer and use ample amounts of superphosphate. If garden is watered, maintain an even soil moisture and avoid overwatering or drying out of soil.
Mosaic (virus): Yellow-green mottling and dwarfing of leaves, many of which may later yellow and drop; stunting of plants. Caused by either the cucumber mosaic or tomato mosaic virus. Occurs throughout the United States.	See cantaloup mosaic and tomato mosaic for control measures. Varieties Burlington and Rutgers World Beater No. 13 are resistant to tomato mosaic but not to cucumber mosaic.

POTATO

3 times natural size.

Colorado potato beetle: Adults yellow and black striped beetles, ⅜ inch long. Larvae brick-red and humpbacked. Defoliates plants. May be very destructive to small plantings. May damage potato and eggplant in all States except California and Nevada. However, its principal damage occurs in the Eastern States. May damage young tomato plants in the Middle Atlantic coastal area.	Dust with DDT (dust mixture 16, p. 25), calcium arsenate (dust mixture 14, p. 25), or cryolite (dust mixture 15, p. 25); or spray with DDT (spray mixture 3, p. 25), calcium arsenate (spray mixture 1, p. 25), or cryolite (spray mixture 2, p. 25). Hand picking of the beetles and crushing of the egg masses is effective if done often.
Flea beetles: Small, black, active jumpers. See flea beetles on beets for a picture of one of these insects. Small holes eaten in leaves by adults. Grubs or larvae buried in tuber. Flea beetles attack potatoes in many parts of the United States. The forms which occur in Washington and Oregon are particularly destructive to the tubers.	Dust with DDT (dust mixture 16, p. 25), or spray with DDT (spray mixture 3, p. 25). Rotenone (dust mixture 18, p. 25, or spray mixture 5, p. 25) is also effective.

Insect or Disease	Remedy
Twice natural size. **Blister beetles:** Rather slender, large, gray, black, or striped beetles, ½ to ¾ inch long. Leaves eaten. Widely distributed and usually occur on late-season potatoes.	Dust with cryolite (dust mixture 15, p. 25), or spray with cryolite (spray mixture 2, p. 25). Hand-pick. Wear gloves while handling because beetles may blister a tender skin.
Leafhoppers: Small, green, active, wedge-shaped insects. See under Beans for an illustration of a leafhopper. Tips and sides of leaves turn brown and curl. May damage potatoes anywhere in its range east of the Rocky Mountains; particularly destructive in the Eastern States.	Dust or spray with DDT (dust mixture 16 or spray mixture 3, p. 25).
Nearly 3 times natural size. **Potato tuber worm:** Pinkish-white worm, up to ½ inch long, with brown head. Tunnels in stems, leaves, and tubers. Shoots wilt and die. Occurs in damaging numbers in restricted localities in certain southern States and in California.	Cultivate well. Keep deeply hilled. Do not leave potato tubers exposed in field after digging. Dust or spray with DDT (dust mixture 16 or spray mixture 3, p. 25).
Common scab (fungus): Causes rough, scabby, raised, or pitted spots on the tubers. One of the most common potato diseases; also affects parsnips, carrots, and beets. Caused by a soil fungus that may be carried on tubers. Common throughout the United States.	Use only clean tubers for seed and avoid planting on land where scab has occurred. Do not use lime, wood-ashes, or fresh stable manure on scab-infested soil. Varieties Menominee, Ontario, Cayuga, and Seneca are resistant to scab.
Late blight (fungus): Causes dark, irregular, dead areas on leaves. Stems also attacked and plants may be killed early in season. Spreads very rapidly in moist, fairly warm weather. Tubers may show a brown rotting in storage. Fungus carried in tubers. Occurs in North-Central, Northeastern, and Atlantic Seaboard States. Also occurs at times on Pacific Coast.	Use tubers showing no decay. If disease commonly occurs, spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), preparations of nabam (used with zinc sulfate and lime) (p. 28), or zineb (p. 28). Ziram is not effective against late blight. Dusts containing copper (p. 28) or zineb (p. 28) can be used. Varieties Sebago, Kennebec, and Essex are resistant. Do not dig blighted plants until tops are dead.
Early blight (fungus): Diseased plants show numerous irregular, dark-brown spots on the leaves. As these spots enlarge they show concentric rings, giving them a targetlike appearance. Much of the foliage may be injured and yields reduced. The fungus, which also causes early blight of tomato, is carried in the soil and may be present in tubers. Common in Central, Southern, and Eastern States.	Spray or dust as for late blight, beginning when spots first appear. Plant only clean tubers.
Mosaic diseases (virus): There are several mosaic diseases which cause various types of light- and dark-green mottling of the leaves, often accompanied by crinkling of the foliage and stunting of the plant. Viruses causing mosaic are carried in tubers and spread by plant lice in the field. Occur wherever potatoes are grown.	Use disease-free seed. Some States have seed-inspection service and produce "certified" seed. Gardeners should use certified seed. Varieties Katahdin, Chippewa, and Sebago are resistant to some forms of mosaic.
Leaf roll (virus): Yellowing and dwarfing of plants and an upward rolling of lower leaves, continuing upward. Leaves leathery to touch. May occur wherever potatoes are grown.	Use disease-free seed as for mosaic. Variety Katahdin has some resistance to leaf roll in foliage, and tubers are resistant to the brown discoloration (net necrosis) caused by this virus. Tubers of varieties Sebago, Kennebec, and Chippewa also are resistant although leaves show leaf roll.

POTATO—Continued

Insect or Disease	Remedy
Wilt and **dry rot** (fungus): Yellowing and drooping of plants in dry weather. Inner portions of stems and tubers show a brown ring. Tubers may rot in storage. Fungus is carried in tuber and can live in soil. May occur anywhere in United States.	Spraying will not control wilt. Do not use seed tubers that show internal discoloration. Endeavor to obtain certified seed. Avoid planting on land where wilt has previously occurred.

RADISH

Flea beetles: Small, black or striped beetles; jump like fleas. See flea beetles on beets for a picture of one of the black flea beetles. Small holes eaten in leaves. Widely distributed; particularly damaging to seedlings.	Same as for flea beetles on cabbage.
Cabbage maggot: See Cabbage.	Use calomel as for cabbage maggot.

RHUBARB

3 times natural size.

Rhubarb curculio (rhubarb weevil): Rather large, yellow-dusted snout beetle. Punctures the stem. Occurs from New England to Idaho and southward to Florida and Louisiana.	Hand-pick. Destroy all dock plants growing in vicinity of beds, as the weevil breeds in dock plants.
Foot rot or **crown rot** (fungus): Brown sunken spots appear at base of leaf stalks; leaves wilt and fall over. Infected stalks later may show soft decay. All leaves of infected plants may finally be attacked. Disease spreads rapidly in row. Occurs in Central and Eastern States.	Dig and destroy infected plants. In making new plantings do not use roots from beds where disease has occurred. Spraying well into crown of plant with bordeaux mixture (spray 8, p. 26) may aid in control but causes unsightly spotting of stalks if applied before harvest.

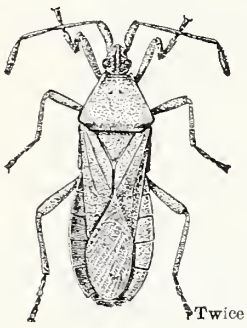
SPINACH

Flea beetles: Greenish-black beetle, ⅛ inch long, with yellow collar. See Flea beetles on beets for a picture of a smaller type of flea beetle. Small holes eaten in the leaves. Common throughout United States.	Same as for flea beetles on cabbage.
Aphids: Greenish-yellow plant lice; clustered on leaves. Generally similar to the aphids found on beans. See illustration there. Leaves curled, distorted. Plants yellowed. Common throughout United States.	Same as for aphids on beans.
Seed-corn maggot: Legless white maggot similar in size and appearance to cabbage maggot. Feeds on sprouting seed and prevents the plant from developing. Particularly destructive to fall and spring crops in the Southern States and may cause losses in many areas of the Eastern States through attacks on germinating seed.	Same as for seed-corn maggot on peas.
Seed decay (fungus): Fungi in soil cause seed to decay and reduce stands of plants. Common throughout United States.	Treat seed with Arasan, Spergon, or Semesan (p. 27).
Blue mold (fungus): Yellow spots on upper surface of leaves, which show a downy, purple, or blue-colored mold on under side. Worst when weather is cool and humidity high. Occurs in Southeastern and Central States.	No preventive treatment. If disease appears, harvest all mature plants at once.

SPINACH—Continued

Insect or Disease	Remedy
Blight or yellows (virus): Plants become yellow, curl, and commonly die. Caused by cucumber mosaic virus and spread by plant lice. May occur anywhere in United States.	Use resistant varieties: Virginia, Savoy, or Old Dominion. See Cantaloup mosaic for other control measures.

SQUASH AND PUMPKIN



Twice natural size.

Squash bug: Brownish, flat-backed stink bug, ⅝ inch long; young stage greenish gray; clustered on runners and fruit. Eggs shiny brick-red in clusters on leaves. Plants wilt and die. May damage squash wherever grown in the United States.	Hand pick adults and eggs. Trap adults under small pieces of board laid on soil around plants. Collect and kill trapped bugs each morning. Dust with 10- to 20-percent sabadilla powder. *Do not use sulfur on squash or pumpkin plants.*

A little larger than natural size.

Squash borer: White worms, up to 1 inch long, boring in vines. Holes in stem near base of runner; runner suddenly wilts. May damage squash east of the Rocky Mountains.	Locate point of attack. Slit carefully through one side of stem and puncture worms with razor blade or sharp knife. Mound dirt around stem so as to prevent drying of the injured plant tissue.
Striped cucumber beetle: See Cantaloup.	See Cantaloup.
Spotted cucumber beetle: See Cantaloup.	See Cantaloup.
Melonworm and **pickleworm:** See Cantaloup.	See Cantaloup.
Aphids: See Cantaloup.	Same as for aphids on beans.
Bacterial wilt: See Cantaloup.	See Cantaloup.
Mosaic (virus): Mottling of leaves and occasionally of fruits; most serious on summer squash. Occurs occasionally throughout United States.	See Cantaloup.

STRAWBERRY

12 times natural size.

Strawberry weevil: Chestnut brown with 2 black spots on back; about 1/10 inch long, with a doubled-under snout half as long as body. Severs stem below fruit bud, allowing no fruit to form. Damages strawberries in the Eastern States, particularly in the midseason and late-producing areas.	Dust with a mixture of 1 pound of cryolite and 3 pounds of dusting sulfur, or 1 pound of calcium arsenate and 5 pounds of dusting sulfur. Do not use after fruits form. Begin treatment about the time first buds appear. See warning regarding residues on page 1

40 times natural size.

Red spiders: Very small, reddish mites; feeding on underside of leaf. Causes leaves to curl, discolor, become covered with webs, and die. Fruit and stems also attacked. Widely distributed and may cause serious damage in some localities.	Dust with fine grade of sulfur. Apply the dust to undersides of the leaves.

Insect or Disease	Remedy
Flea beetles: Small, green, coppery, or blue beetles, about ⅛ inch long. See flea beetles on beets for a picture of a smaller type of flea beetle. Holes eaten in the leaves. Widely distributed; may cause damage in certain localities.	Same as for strawberry weevil, but do not apply cryolite or calcium arsenate after first fruits form. See warning regarding residues on page 1.
9 times natural size. **Strawberry leaf beetle:** Nearly black to reddish yellow, sometimes with four darker spots on wing covers; ⅓ inch in length. Eats holes in leaves, feeding at night. Widely distributed and causes damage periodically in certain localities.	Same as above. Do not use after fruits form. See warning regarding residues on page 1.
5 times natural size. **Strawberry root weevil:** Very dark brown or almost black snout beetle, ¼ inch long. Eats off roots near the crown. Widely distributed but is particularly destructive in berry-growing areas of the Western States.	Poisoned bait (poison bait 27, p. 26) dropped around plants when insect appears. See warning regarding residues on page 1.
Leaf spot (fungus): Spots ¼ to ½ inch in diameter, varying in color from brown to white with purplish border, depending on causative organism. Occurs in almost all regions where strawberries are grown; most severe in Gulf States.	Not often serious. If severe, spray with bordeaux mixture (spray mixture 8, p. 26) or a fixed copper fungicide (p. 27) as soon as new spring growth starts, and repeat every 10 days until first berries are one-third grown. When making new plantings, remove all old leaves. After harvest cut off all old leaves and burn them at once.
Leaf variegation or **June yellows** (noninfectious): Leaves mottled or streaked with yellow. Occurs mainly on varieties Blakemore and Premier. May occur wherever these varieties are grown.	No cure known. Do not use runner plants from affected mother plants, as they will also be variegated. When ordering plants of Blakemore and Premier, specify "yellows-resistant" strains.
Red stele (fungus): New leaves small, slightly bluish, with short petioles. Plants wilt and die about fruiting time. Fibrous roots die and larger live roots have red center. Fungus thrives in poorly drained soil. Occurs on Pacific coast and in the Central, Northeastern, and Middle Atlantic States.	Dig out and burn diseased plants. Fungus lives in soil for some years; therefore it is inadvisable to replant on the same plot unless resistant varieties such as Temple, Aberdeen, Pathfinder, Sparkle, or Fairland are used. Some States have red stele plant inspection service and produce plants for shipment relatively free from the disease. Home gardeners should use disease-free plants for new plantings.
Yellows and **crinkle** (viruses): Yellowing, dwarfing, crinkling, and twisting of leaves. Plants do not die, but berry crop is reduced. The two diseases are prevalent in Pacific Coast States.	No cure known for diseased plants. Only disease-free plants should be set in new plantings. Rogue out any plants that show symptoms. All runner plants from a diseased mother plant have the disease.

STRAWBERRY—Continued

Insect or Disease	Remedy
Berry rots (fungus): Decayed fruit varies in color and texture, depending on the organism causing the rot. May occur wherever strawberries are grown.	Berry rots cause most damage when rain occurs at time of harvest. Mulching to keep berries from contact with soil gives some control. Space plants 6–8 inches apart to prevent shading of berries. Do not use nitrogenous fertilizers early in spring that will stimulate heavy growth of leaves.

SWEET CORN

A little less than natural size.

Corn earworm: Green or brown, with light stripes along sides and back. This same insect is called the tomato fruitworm when it is found on tomatoes. Eats corn kernels near the tip of the ear after entering through the silk. Damages corn during some part of the season wherever it is grown in the United States.

Spray the silks until they are wet with DDT emulsion (spray mixture 11, p. 26) as soon as 90 to 100 percent of the ears are in silk; or inject ¼ teaspoonful of medicinal mineral oil into the base of the silk mass (fig. 9, p. 30) with an oil can or a medicine dropper (½ dropperful) as soon as the silks become wilted, or about the fourth day following silk exposure.

Slightly more than natural size.

European corn borer: Pale-colored worm tinged with pink and brown, about 1 inch long. Feeds in stalks and ears of corn. Distributed generally from northern part of South Carolina northward to Maine and westward to North Dakota, Colorado and Oklahoma, and may cause serious damage to sweet corn in certain areas.

Spray with DDT (spray mixture 3, p. 25) when the first-laid eggs begin to hatch. Use about 1½ gallons per 100 stalks, applying to center of leaf whorls and ear shoots until the spray runs off at base of plant. Repeat at least 3 times at 5-day intervals. A 10-percent DDT dust thoroughly applied to center of leaf whorls and ear shoots, following same schedule as for sprays, is also useful.

Seed-corn maggot: See Beans.

See Beans.

Bacterial wilt: Plants are dwarfed and may wilt and dry up. Tassels turn white early. If stalks are cut, there is a yellow, slimy, bacterial ooze. May be carried on seed and also is carried over winter by insects that also spread the disease in the field. Common in Central, Southern, and Eastern States.

Use resistant varieties, such as Stowell's Evergreen, Golden Cross Bantam, Marcross, Spancross, or Whipcross; other quite resistant varieties are listed by seedsmen. Most of the white late varieties are somewhat resistant.

SWEETPOTATO

6 times natural size.

Sweetpotato weevil: Adult, ¼ inch long, a shiny, antlike, slender-bodied snout beetle, with blue-black head, wing covers, and abdomen; legs and middle of body bright red. Grub, ⅜ inch long, legless, white, with pale-brown head. Grubs tunnel potatoes and vines. Damages crop along the Gulf Coast, and in southern Texas, Georgia, and Florida.

Plant uninfested roots and plants or slips. Keep plants well hilled with soil. After harvest destroy plants and tubers that are infested.

5 times natural size.

Tortoise beetles: Either golden hued, spotted, striped, or mottled, tortoise-shaped or flat-oval-bodied. Eat holes in the leaves or destroy them entirely. Widely distributed.

Dust with undiluted calcium arsenate, or cryolite (dust mixture 15, p. 25). Rarely become abundant enough to require treatment of crop.

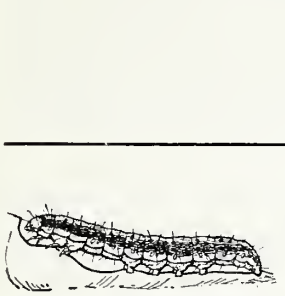
Stem rot (fungus): Yellowing and wilting of plants. When cut across, the stems show a black discoloration and roots show a black ring. Caused by a fungus which enters and grows in the water vessels of roots and stem. Common wherever sweetpotatoes are grown.

In buying plants make sure that they have clean, white roots. Any plants that fail to grow normally and have yellowed leaves should be destroyed. Do not plant on the same land each year.

SWEETPOTATO—Continued

Insect or Disease	Remedy
Black rot (fungus): Produces black, sunken, roundish spots of various sizes on the sweetpotato and black cankers on underground parts of the stems. Fungus lives over in diseased roots and attacks slips in the plant bed. Spreads in storage. Common wherever sweetpotatoes are grown.	Same as for stem rot.

TOMATO

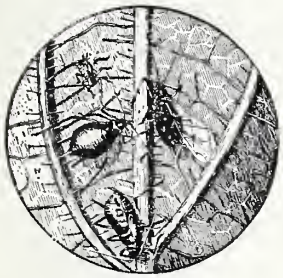


A little less than natural size.

Tomato fruitworm: Green or brownish worm up to 1¾ inches long with light stripes. Eats holes in fruit and buds. Widely distributed. Damages tomato in Southern States and in California annually; periodically causes losses by fruit damage in other States.	Dust with 10-percent DDT, or cryolite (dust mixture 15, p. 25); or apply poisoned bait (poisoned bait 25, p. 26) when plants are 1 to 2 feet across, or as soon as fruits of main crop begin to set. Repeat at 2-week intervals until 3 applications have been made. See warning regarding residues on page 1.
Colorado potato beetle: See Potato.	Same as for this insect on potato.

About ⅓ natural size.

Hornworms: Large, green worms, with "horn" on back end of body. Defoliate plants. Widely distributed; in some areas cause serious damage.	Hand-pick.
Flea beetles: Small, black, brown, or striped beetles; very active, jump like fleas. See flea beetles on beets for a picture of one of the black type of flea beetles. Eat small holes in leaves. Widely distributed and may damage young tomatoes wherever grown.	Same as for flea beetles on potato. Since these insects are particularly destructive to newly transplanted tomatoes, especially if plants wilt from lack of water, treat when plants are set out and transplant at a period when newly set plants will not suffer from lack of moisture.



5 times natural size.

Aphids: Small, pink and green, sucking plant lice. Leaves curl; plant yellowed. Tomatoes grown in the Eastern States are subject to aphid infestation to a greater extent than those grown elsewhere. However, damage occurs only locally in this region.	Same as for aphids on beans.
Damping-off (fungus): Seed decay and wilting and death of very young seedlings.	Treat seed with Arasan, Semesan, or Spergon (p. 27).
Early blight (fungus): Numerous brown spots on leaves which enlarge into circular spots with targetlike markings. Stems show brown cankers which may girdle seedlings at ground line (collar rot). Fruits may develop dark, leathery, decayed spots at stem scar. Fungus lives in soil and may be carried on seed. Worst in warm, moist weather. Common in all but semiarid regions.	Never use seedlings showing stem cankers or leaf spots. After first fruit sets, spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or fungicides containing nabam (used with zinc sulfate and lime), zineb, or ziram (p. 28). Dusts containing copper (p. 28), zineb, or ziram (p. 28) can be used.
Leaf spot (fungus): Leaves show many small spots with light centers and dark margins. Centers of spots are covered with tiny, dark specks. Severely diseased leaves are killed and crop may be reduced. Fungus lives in soil and on weed hosts. Worst in warm, moist weather. Common in North Central, Northeastern, and Southeastern States.	Remove or turn under tomato vines in fall. Destroy perennial weeds near garden. Rotate crop. If leaf spotting appears, spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or use copper dusts (p. 28). Organic fungicides are not very effective for leaf spot control.

TOMATO—Continued

Insect or Disease	Remedy
Late blight (fungus): Leaves first show dark, water-soaked spots; these enlarge, turn brown, and wither. In moist weather, undersides of leaves show a white growth of the fungus. Fruits show large, water-soaked spots that turn brown and remain firm. Disease is favored by cool, moist weather. May occur in humid regions wherever tomatoes are grown, particularly east of the Mississippi River.	Spray with bordeaux mixture (spray mixture 8, p. 26), fixed coppers (p. 27), or preparations of nabam (used with zinc sulfate and lime) (p. 28), or zineb (p. 28). Ziram and ferbam are not effective against late blight. Dusts containing copper (p. 28) or zineb (p. 28) can be used. Make first application about 30 days after the first blossoms appear unless disease appears earlier. Repeat application every 7 to 10 days.
Fusarium wilt (fungus): Gradual yellowing and wilting of the foliage, beginning with the lower leaves. Plants may eventually die, and yield is greatly reduced. Browning of the woody tissue just under the outer green portion of the stem is characteristic of the disease. Caused by fungus which lives for many years in the soil. May occur wherever tomatoes are grown but is most common in Southern States.	Spraying or dusting is of no value for wilt control. Use wilt-resistant varieties. Pan America, Southland, Jefferson, and Sunray (a yellow variety) are highly resistant. Marglobe, Rutgers, Pritchard, Pearson, and Break O'Day are somewhat less resistant but usually make fair crops on infested soil.
Mosaic (virus): Green and yellow mottling of foliage, which is often curled and slightly dwarfed. Plants stunted if infected early in the season. Caused by same virus as tobacco mosaic, which lives over winter in certain weeds and is often present in manufactured tobacco. Spread by handling or brushing plants and by plant lice. Virus is not carried in seed and does not live long in soil. Common throughout the United States.	Spraying or dusting is of no value. Avoid handling young plants unnecessarily and do not smoke while working with seedlings, since smokers may carry virus on their hands. Washing hands with soap and water removes virus. Keep down weeds in and about the garden.
Blossom-end rot (physiologic): Fruits develop large, dark, sunken, leathery spots at the blossom end. Occurs as a result of an insufficient supply of water for both foliage and fruit. Found wherever tomatoes are grown, particularly during or just after periods of drought.	Avoid excessive use of nitrogenous fertilizers, particularly stable manure, and use ample quantities of superphosphate. If garden is watered, maintain an even supply of moisture in soil.
Root knot (nematode): Great numbers of gall-like swellings on roots. Plants yellowed and stunted. Caused by minute nematodes (eelworms) in soil. Most common in Southern States.	Rotate crop and avoid land known to be heavily infested with nematodes. Grow seedlings in nematode-free soil. Burn roots of diseased plants.

TURNIP

20 times natural size.

Aphids: Small, greenish, sucking plant lice, on under side of leaves. See illustration under beans. Leaves curl, yellowing plants. Turnips wherever grown are subject to aphid infestation, but aphids are particularly destructive in the Southeastern States.	Same as for aphids on peas. Treatment should begin early to prevent infestations from building up.
Flea beetles: Small black or striped beetles; jump like fleas. Small holes eaten in leaves. Destructive in the seedling stage. Wherever turnips are grown they are subject to injury by flea beetles.	Same as for flea beetles on beets. See warning regarding residues on page 1.
Caterpillars: See Cabbage.	Same as for caterpillars on cabbage.
Harlequin bug: See Cabbage.	See Cabbage.
Cabbage maggot: See Cabbage.	Same as for cabbage maggot on cabbage.

WATERMELON

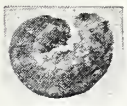
Insect or Disease	Remedy
Striped cucumber beetle: See Cantaloup.	See Cantaloup.
Spotted cucumber beetle: See Cantaloup.	See Cantaloup.
Aphids: Small, light-green to black, soft-bodied insects. Leaves curled, distorted, yellowed. Not so subject to injury by aphids as is cantaloup, but injury may occur wherever watermelons are grown.	Same as for aphids on beans. *Do not use sulfur on watermelon vines.*
Anthracnose (fungus): Dark spots on leaves may be so numerous as to give a scorched appearance. Fruits show round, water-soaked spots that at first are raised and later sunken. See cantaloup.	See Cantaloup. The variety Congo is moderately resistant but requires spraying or dusting for full protection from anthracnose.
Wilt (fungus): Stunting and death of seedlings and wilting of older plants beginning at tips of runners and spreading throughout the vine. Fungus lives indefinitely in soil and is carried on seed. Not identical with bacterial wilt of cucumber and muskmelon. Severe in South and in some parts of Central States.	Where wilt occurs use resistant varieties such as Kleckley No. 6, Improved Stone Mountain No. 5, Hawkesbury, Leesburg, Blacklee, or Klondike R–7. Rotate crop.

GENERAL FEEDERS

5 times natural size.

Ants: Small insects ranging from less than 1/16 inch to 1/2 inch or more in length. Many different colors represented, including black, brown, yellow, and red. Three distinct body segments. Ordinarily live in colonies. In many cases ants do not cause real damage in vegetable gardens, but their presence is annoying. In some instances, however, they feed on and injure seriously the leaves, stems, fruits, or roots of growing vegetables. In addition, their activities around the roots of plants cause excessive drying of the soil and indirect injury to affected plants. Widely distributed and may cause serious damage in some localities.

Use one of the ready-prepared ant baits in the form sold by dealers. Follow directions given on the package. Some kinds of ants respond to some types of baits, and their response may vary from time to time; therefore, they are not easy to control. Ants may also be controlled by spraying or sprinkling the infested soil with 1 ounce of 50-percent chlordane wettable powder per 10 gallons of water. Apply the spray at the rate of 4 gallons per 100 square feet and follow with 4 gallons of water. Chlordane is not recommended for use on soil in which potatoes are to be grown.



About natural size of common species.

Cutworms: Dull-gray, fat worms, 3/4 to 1 1/4 inches long. Young plants cut at surface of ground. Cutworms occur in all sections of the country and are particularly destructive during the early part of the season.

Use poison bait (poison bait 24, p. 26) scattered lightly at base of plants. A collar of stiff cardboard rolled and set in the soil around the stem of transplants, such as cabbage or tomatoes, will aid in preventing cutworm injury. The collar, when in place, should be about 1/2 inch distant from the plant stem and should extend about 1 inch below and 2 inches above the soil (fig. 10, p. 30). Dust or spray with DDT (dust mixture 16 or spray mixture 3, p. 25).

About natural size.

Grasshoppers: Of many species, all with strong hind legs for jumping; most forms strong fliers. Feed on any available vegetation, and when abundant may destroy a complete planting. Widely distributed, but especially troublesome in the Central Northwest.

Scatter poisoned bait 24 (p. 26) thinly over the ground about, but not on, the plants. Apply in the morning as the grasshoppers become active. Dust field margins with 5-percent chlordane or spray with chlordane (spray mixture 7, p. 25). Do not apply chlordane to vegetable crops.

Insect	Remedy
3 times natural size. **Japanese beetle** (as a vegetable-garden pest): The parent, or beetle, is oval, nearly ½ inch long, about ¼ inch wide, and shining metallic green. Outer wings are coppery brown. The fully-grown grub, or larva, is about 1 inch long, with a white body and a brown head. This insect is a general feeder. Among the vegetables, the beetles are most likely to feed on the foliage of beans, asparagus, okra, and rhubarb and on the silk and foliage of sweet corn. Grubs feed on the roots of various plants, including bean, tomato, beet, sweet corn, onion, and strawberry. Present in destructive abundance in many localities from central New England to Virginia and eastern Ohio.	*Before parts of the plant that are to be eaten are exposed*, spray with DDT (spray mixture 3, p. 25) or dust with 5-percent DDT. *After parts of the plant that are to be eaten are exposed*, plants may be partially protected by dusting with 0.75-percent rotenone or with hydrated lime or by spraying with rotenone (spray mixture 5, p. 25).
About natural size. **Millipedes:** Brown or grayish, hard-shelled, wormlike creatures, 1 to 1¼ inches long. Feed on roots, tubers, bulbs, and fleshy stems of plants and on seeds planted in soil. Found commonly under shelter, such as boards or flowerpots, or in decayed manure. Widely distributed.	Apply bait (poisoned bait 24, p. 26) to infested premises, or apply DDT (spray mixture 3, dust mixture 16, p. 25). Destroy or dispose of hiding places.
Slightly less than natural size. **Mole crickets:** Light-brown insects, 1½ inches long, faintly resembling field crickets. Large, beady eyes, and short, stout front legs bearing shovellike feet. Make burrows in upper inch or two of soil, like those of a small ground mole. Uproot seedlings. Destructive types of mole crickets occur in the coastal areas of North Carolina, South Carolina, Georgia, Alabama, and Mississippi and in Florida.	Use poisoned bait (poisoned bait 26, p. 26) scattered lightly in all infested parts of garden. For best results apply bait in late afternoon following a rain or artificial application of water.
Less than natural size. **Slugs and snails:** Slugs as illustrated are black, shiny snails without shells. Eat leaves of small plants at night. Leave a glistening, slimy trail. Widely distributed and are particularly destructive on the West Coast.	Dust soil in infested parts of garden with hydrated lime. Spray plants with bordeaux mixture (spray mixture 8, p. 26). Use commercially-prepared baits containing metaldehyde.

GENERAL FEEDERS—Continued

Insect	Remedy
Twice natural size. **Sowbugs** or **pillbugs:** Dark-gray, oval, flattened bodies, with seven pairs of legs, ½ inch long. Not true insects. Feed upon roots and tender parts of plants. Found in same situations and territory as millipedes.	Destroy hiding places. Spray or dust with DDT (spray mixture 3, dust mixture 16, p. 25).
4 times natural size **Vegetable weevil:** Dull grayish-brown weevil ⅜ inch long, with 2 oval pale-gray marks on back. Larvae, or grub, ⅝ inch long, with light-green body and light-yellow to brown head. Weevils and grubs feed on leaves and roots of many vegetables, including turnips, carrots, mustard, spinach, tomatoes, and potatoes. Has been destructive in the Southern States and in limited coastal areas of California.	Use poisoned bait (poisoned bait 28, p. 26) scattered lightly on soil surface along edge of garden or between rows of plants. Ready-prepared baits containing sodium fluosilicate and finely ground apple pulp, in the form sold by dealers, are also suitable for this purpose. Susceptible crops with foliage that is ordinarily not eaten by humans can be protected from injury by calcium arsenate spray (spray mixture 1, p. 25), or undiluted calcium arsenate dust, or by a DDT spray (spray mixture 3, p. 25) or DDT dust (dust mixture 16, p. 25).
About natural size. **White grubs:** Large white or light-yellow grubs, ½ to 1½ inches long, with hard brown or black heads. Live entirely in soil during larval stage. Usually found in curved position. Feed on roots or underground stems of plants and on potato tubers. Widely distributed and may cause severe damage in some localities.	No remedy except prevention. Avoid abandoned or newly plowed grassland. If white grubs are found when spading or plowing the garden, sow an extra quantity of seed and thin out later. Plow or spade deeply in the late fall or during winter, if weather conditions permit.
About natural size. **Wireworms:** Slender yellow to white worms, with dark head and tail, resembling a jointed wire. Puncture and tunnel stems and roots. Widely distributed and are more destructive in some areas than in others; particularly destructive in irrigated lands of Western States.	Avoid planting very susceptible crops in soils infested with wireworms. Deep cultivation in midsummer and heavy fertilization will help counteract wireworm damage. DDT will slowly kill the wireworms that cause damage in irrigated lands in the Western States and prevent reinfestation for several years. Apply 1 ounce of 50-percent DDT wettable powder in 1 gallon of water per 150 square feet or 5 ounces of 10-percent DDT dust. Thoroughly mix the DDT with the top 6 or 8 inches of soil. For other wireworms use chlordane instead of DDT and apply as for DDT. Chlordane is not recommended for use in soil in which potatoes are to be grown.

General Methods of Insect and Disease Control

Although many of the control measures recommended in this publication include the use of insecticides and fungicides, there are other generally useful practices, such as those given in the following paragraphs, that aid in the control of insects and diseases attacking vegetables and do not require the use of insecticides or fungicides.

Insect Control—General Methods

Small seedlings may be protected from insects, excepting those living in the soil, by covering the plants with an inverted glass jar or completely covering them with a light paper or muslin hood. Such hoods are usually about 8 inches in diameter and are supported by wire or wooden hoops and sealed to the ground by covering the edge of the hood with soil.

Hand picking of the larger beetles, caterpillars, and plant bugs will often give satisfactory control in a small garden and eliminate the need for applying insecticides. Hand picking is most effective if begun early enough to catch the first insects attracted to the vegetables.

Disease Control—General Methods

Plant diseases can rarely be cured, but it is possible to prevent their occurrence and spread. Disease control should begin with the seed and continue until harvest. The control measures described in this section include directions for the preparation and use of the chemical seed treatments and sprays and dusts already mentioned.

Good Garden Practices

The methods of gardening essential to the production of good crops are also an aid in disease control. These practices include (1) the use of fertile, well-drained soils; (2) the proper application of fertilizers of a type suited to the soil and crop; (3) the planting of crops and varieties suited to the soil and climate; and (4) clean cultivation.

Sanitation

At the end of the season all diseased crop refuse, including the roots, should be disposed of by burning. Do not compost the remains of diseased plants. Keep down weeds in the vicinity of the garden, since they may harbor disease-producing viruses or fungi. The garden should be so planned that the same crop or related crops, such as cabbage and cauliflower or tomatoes, peppers, and eggplant, are not grown in the same spot in successive years.

Seed and Plant Selection

Obtain disease-free seed. Where certified seed is available, as with tomatoes and potatoes, endeavor to obtain it. Cabbage, cauliflower, bean, and pea seed grown in the far West is ordinarily free from certain disease-producing organisms. Never save seed from decayed or spotted fruits or from wilted plants.

When seedling plants are purchased, make sure they do not show swellings on the roots, stem cankers, or leaf spots. If southern-grown tomato plants are used, it is best to buy State-certified plants.

Use of Resistant Varieties

Resistant varieties offer the most effective means of disease control, but such varieties are as yet available in the case of only a few diseases of certain crops. The number of highly resistant varieties is also limited, but a larger group of disease-tolerant varieties exists, and these, while not entirely resistant, are comparatively slightly injured. Valuable examples of resistant varieties are available in cabbage, tomato, watermelon, beans, peas, and potatoes; and the names of many of these varieties are given in the lists of diseases.

Seed Treatment

Chemical seed treatments are used for two purposes, (1) protection against decay of seed in the soil and the damping-off of small seedlings, and (2) the disinfection of the seed to kill any parasitic fungi or bacteria that may be present on its surface (p. 27). The same treatment, however, does not necessarily serve both purposes. It must also be remembered that seed treatment does not insure the freedom of the plant from all diseases, although it is a very valuable means of disease control.

How to Prepare Insecticides and Fungicides for Garden-Pest Control [2]

Insecticides

The following formulas and directions are given for the preparation of spray and dust mixtures and poisoned baits needed for the control of the more common insects and related pests attacking vegetables in farm, suburban, city, and community gardens, as listed in this publication. These directions have been made as simple and as uniform as possible, with due regard to the saving of insecticides and the prevention of harmful residues on the plants or in the soil. Small measures are given for each of the ingredients in order to guide the gardener in preparing small quantities of the finished insecticide.

[2] Before attempting to prepare any of these insecticides or fungicides, refer to the warnings given on p. 1 and read them carefully.

Spray mixture 1: CALCIUM ARSENATE:

Calcium arsenate	1 ounce (5 level tablespoonfuls).
Hydrated lime	3 ounces.
Water	1 gallon.

Spray mixture 2: CRYOLITE:

Cryolite	1 ounce (8 level *teaspoonfuls*).
Water	1 gallon.

Do not use lime or bordeaux mixture with cryolite.

Spray mixture 3: DDT:

DDT wettable powder, 50-percent	2 level tablespoonfuls.
Water	1 gallon.

Spray mixture 4: NICOTINE SULFATE:

Nicotine sulfate (40 percent) [3]	1 tablespoonful.
Soap (mild laundry type)	1 cubic-inch cake (or 2 level tablespoonfuls of soap flakes).
Water	1 gallon.

Dissolve soap in 1 pint of warm water. Add nicotine sulfate. Stir this mixture and add enough water to make 1 gallon.

Spray mixture 5: ROTENONE:

Derris or cube root powder (5 percent rotenone content)	½ ounce (3 level tablespoonfuls).
Water	1 gallon.

If the available powder is of lower rotenone content, use proportionally more of it.

Mix the powder first with a small quantity of water, then add it to the rest of the water in the sprayer.

Spray mixture 6: PYRETHRUM:

Use a ready-prepared pyrethrum spray material at the dilution given on the package in which it is sold.

Spray mixture 7: CHLORDANE:

Chlordane wettable powder, 50-percent	2 level tablespoonfuls.
Water	1 gallon.

[3] The strong nicotine sulfate solution (40 percent) is very poisonous, and care should be taken not to get it on the skin or about the eyes or mouth.

Dust mixture 14: CALCIUM ARSENATE:

Calcium arsenate	1 pound.
Hydrated lime	2–3 pounds.

Place the materials in a tight can or similar container. Add several stones 1 inch in diameter to aid mixing process. Place tightly fitting cover on can. Shake or rotate can for 5 minutes. Remove stones by passing mixture through sifter or screen.

Dust mixture 15: CRYOLITE:

Cryolite	2 pounds.
Talc	1 pound.

Do not use lime or bordeaux mixture with cryolite.

Dust mixture 16: DDT:

Use a ready-prepared 3-percent DDT dust in the form sold by the dealer.

Dust mixture 17: NICOTINE SULFATE (3 percent):

Nicotine sulfate (40 percent)	1 ounce (5 *teaspoonfuls*).
Hydrated lime	1 pound.

Sift lime to break up lumps. Put sifted lime in tight can. Add several stones 1 inch in diameter to aid mixing process. Pour nicotine sulfate over lime. Place tight-fitting cover on can. Shake or rotate can for 5 minutes. Remove stones by passing mixture through sifter or screen.

Dust mixture 18: ROTENONE:

Use a ready-prepared dust mixture containing at least 0.75 percent of rotenone in the form sold by the dealer.

Dust mixture 19: PYRETHRUM:

Use a ready-prepared pyrethrum dust or dust mixture in the form sold by the dealer. Follow directions given on the package in which it is sold.

To prepare a home-made pyrethrum dust mixture use—

Ground pyrethrum flowers (1.3 percent total pyrethrins content)	1 pound.
Talc, pyrophyllite, or tobacco dust	3 pounds.

Mix by same method as dust mixture 14 (above).

Dust mixture 20, which was described in M. P. 525, is no longer recommended.

Spray mixture 8: BORDEAUX MIXTURE:

Bluestone (copper sulfate)	4 ounces.
Hydrated lime	4 ounces.
Water	3 gallons.

Dissolve the bluestone in a wooden, earthenware, or glass vessel (*never in metal*), using hot water. Dilute with half the total water specified. Make a paste of the lime in a small quantity of water, and add the rest of the water to this. Pour the diluted bluestone and lime solutions together and mix thoroughly. Strain the mixture through a fine cheesecloth directly into the sprayer, and it is ready for use.

This mixture should be made fresh each time it is used.

Spray mixture 9: BORDEAUX MIXTURE-CALCIUM ARSENATE:

Add 3 ounces of calcium arsenate to 3 gallons of bordeaux mixture, made according to directions just given. Mix thoroughly.

Spray mixture 10, which was described in Miscellaneous Publication 525, is no longer recommended.

Spray mixture 11: DDT EMULSION:

DDT emulsifiable concentrate, 25-percent	4 fluid ounces.
White mineral oil	12 fluid ounces.

Shake together in a jug. Add enough water to make 1 gallon and shake again until the mixture is uniformly white. Shake the mixture often while spraying.

Spray mixture 12: SOAP:

Soap (mild laundry type)	2 ounces (4 cubic-inch cakes or 8 level tablespoonfuls of soap flakes).
Water	1 gallon.

Cut cake soap into very small pieces. Dissolve soap in quart of hot water. Let cool. Add sufficient water to make 1 gallon. Use half strength on very tender plants such as young cabbage, garden peas, and beans.

Solution 13: CORROSIVE SUBLIMATE:

Corrosive sublimate (mercuric chloride)	1/10 ounce (six 7½-grain tablets).
Water	1 gallon.

Dissolve the corrosive sublimate in a pint of hot water in a glass or earthenware vessel. Then dilute with quantity of cold water required to make 1 gallon.

Calomel (mercurous chloride) may be substituted for corrosive sublimate at the rate of 1/10 ounce to 1 gallon of water.

Dust mixture 21: SULFUR-PYRETHRUM:

Dusting sulfur	1½ pounds.
Pyrethrum flowers (1.3 percent total pyrethrins content)	1 ounce (5 tablespoonfuls).

Do not use sulfur on squashes, melons, or cucumbers.

Mix by same method as dust mixture 14 (p. 25).

Dust mixtures 22 and 23, which were described in Miscellaneous Publication 525, are no longer recommended.

Poisoned bait 24: CUTWORM BAIT:

Sodium fluosilicate or paris green	¼ pound.
Dry, flaky wheat bran	5 pounds (1 peck).
Water to moisten	3 or 4 quarts.

Mix thoroughly the poison and the dry bran. Then moisten the mixture with water until each flake of the bran has been wetted. Prepare this bait in the morning and apply it late in the day, so that it will be moist and attractive when the cutworms begin to feed in the evening. Scatter the bait lightly and evenly on the soil surface of the garden or around the bases of plants that have been set out. Repeat application, if necessary.

Poisoned bait 25: TOMATO FRUITWORM BAIT:

Cryolite	½ pound.
Corn meal	5 pounds.

Sift corn meal to break up or remove all lumps. Put one-fourth of corn meal in bucket or similar container. Add one-fourth of poison to corn meal. Mix thoroughly. Repeat process until entire quantity is mixed. Scatter the bait lightly and evenly over the leaves of tomato plants, especially the fruit clusters, growing tips, and outer leaves.

Poisoned bait 26: MOLE CRICKET BAIT:

Sodium fluosilicate	½ pound.
Dry wheat bran	5 pounds (1 peck).
Water	1 to 2 pints.

Mix by same general method as poisoned bait 24, but add only sufficient water to the dry bran and poison to cause the bait particles to cling together when squeezed in the hands. Scatter the bait lightly and evenly on the soil surface of infested gardens.

Poisoned bait 27: STRAWBERRY ROOT WEEVIL BAIT:

Calcium arsenate	½ pound.
Dry wheat bran	5 pounds (1 peck).
Water	2 quarts.

Mix by same method as poisoned bait 24. Scatter bait lightly and evenly around plants as soon as presence of insect is detected.

Poisoned bait 28: VEGETABLE WEEVIL BAIT:

Sodium fluoride	½ pound.
Fresh, finely chopped carrots or turnips	4 pounds.
Dry wheat bran	7 pounds.
Water to moisten	3 or 4 quarts.

Mix bait by method described for poisoned bait 24. Then mix chopped vegetables with the prepared bait. This bait is more attractive to the weevils if allowed to stand several hours before it is applied. Apply in the late afternoon. The bait is effective only late in the winter and in the spring, since at other times of year the weevils prefer growing crops.

Treatments for Prevention of Seed Decay and Damping-Off

Seed decay and damping-off can be controlled by dusting the seed with various chemical compounds, some of which are listed below. The treatments here described are generally effective except as noted. The amount of dust needed for treating seed is very small. For a small packet of seed tear off one corner and drop in as much of the chemical as can be lifted on ¼ inch of the tip of the small blade of a pen knife. Then fold the corner of the packet and shake the seed thoroughly to coat it with the chemical. In treating larger quantities of seed, such as corn or beans, place the seed and dust in a closed container and shake for 1 to 2 minutes, after which the excess dust is screened off and the seed is ready to plant. When treating seed in this way, use the amount of chemical dust recommended by the manufacturer on the package. The following chemicals give effective seed protection and, aside from the exceptions noted, may be used on any of the vegetable crop seeds.

Spergon and Arasan.—These compounds contain no copper or mercury and can be used on practically all vegetable seeds with good results. Spergon is especially effective on lima beans and peas. Directions for their use come with the package. One level teaspoonful is enough for a pound of seed.

Semesan.—An organic mercury compound that can be used on all vegetable seeds except lettuce and lima bean. Directions for its use on various seeds come with the package. One-half level teaspoonful is enough for a pound of seed.

Seed Disinfectants

Various chemicals are used to destroy disease-producing organisms on the seed surface. Those here listed are generally effective when used as recommended. It is advisable to consult your county agent or State agricultural college if in doubt as to what to use on any crop.

Corrosive sublimate.—Some seed-borne organisms often can be controlled by treating the seed with a corrosive sublimate solution. This is used at various strengths as shown below. The seed is placed in a loose cloth bag not over half full and soaked for the time indicated. Always use three times as much solution as seed by volume, and stir the solution during the treatment. This chemical corrodes metal and must be used in earthenware, glass, or wooden containers only. After the seed has been soaked it should be rinsed in running water or in several changes of water for 15 minutes and dried at once.

Treat the seed as follows:

Cucumber, muskmelon, and watermelon: Soak seed 5 minutes in a 1:1,000 solution.

Eggplant: Soak seed 10 minutes in a 1:1,000 solution.

Pepper: Soak seed 5 minutes in a 1:2,000 solution.

Tomato: Soak seed 5 minutes in a 1:2,000 solution.

A 1:1,000 solution (1 ounce to 7½ gallons of water) can be made in small quantities by dissolving one of the prepared tablets sold by druggists in 1 pint of water; a 1:1,500 solution by using one tablet to 1½ pints of water; and a 1:2,000 solution by adding one tablet to 2 pints of water.

This treatment does not protect against damping-off, and if this protection is desired, the seed must be given a second treatment with one of the chemical protectants listed above.

Semesan.—A solution of Semesan in water can be used as a disinfectant for most vegetable seeds. The solution should be made according to the directions accompanying the package.

Spraying and Dusting

The use of chemicals applied as sprays or dusts is a valuable means of controlling many diseases of vegetable crops. However, these fungicides only prevent and cannot cure disease. To be effective they must be applied as soon as there is any sign of disease and preferably before it appears. Only those parts of the plant are protected that are thoroughly coated with the fungicide. Sprays stick to the foliage better than dusts, and spraying is preferable to dusting if done with a compressed-air (fig. 2) or knapsack sprayer (fig. 3) that delivers a fine mist under fairly uniform pressure. On the other hand, dusts are easier to apply and the equipment is less expensive and easier to keep in working order. When dusts are used they should be applied when the air is still and preferably when the plants are wet with dew. Diseases controlled by spraying or dusting are most severe in moist weather, and more frequent applications are necessary during long periods of wet weather. Applications generally should be made every 7 to 10 days.

Many diseases are not controlled by sprays or dusts and there are other diseases which usually are not damaging enough to require the use of fungicides for their control. Potatoes, celery, cucumbers, melons, and tomatoes commonly require the application of fungicides, but a number of other crops rarely need such treatments. The fungicides listed below are those generally recommended for use on vegetable crops.

Copper Fungicides

Sprays.—Bordeaux mixture, one of the oldest fungicides, is effective in disease control but somewhat more likely to injure the plants than are the fixed copper and organic materials mentioned later in this paper. This mixture can be prepared in 3-gallon quantities, as given on page 26. It should always be freshly prepared because the home-made product does not keep well. Always wash the sprayer immediately after use.

Prepared bordeaux can be purchased in convenient packages and is often most satisfactory for a very small garden, but the freshly prepared mixture is more effective and less expensive. Consult the section on Insecticides (p. 26) for directions on how to combine an insecticide with bordeaux mixture.

There are a number of "fixed" or "neutral" copper compounds, including basic copper sulfate, copper oxychloride, copper oxychloride sulfate, cuprous oxide, and other compounds, that are used as sprays for vegetable disease control. These

materials are sold under various trade names and should be used as directed by the manufacturer on the package. They are less likely to injure the foliage of young plants of tomatoes, cucumbers, and cantaloups than is bordeaux mixture.

Dusts.—A dust composed of 20 parts of monohydrated copper sulfate and 80 parts of hydrated lime is often used on vegetable crops. It can be purchased ready mixed. This mixture should be applied when the foliage is wet.

The fixed copper compounds mentioned above are also mixed with talc, or some other light, inert ingredient for use as dusts. Dusts containing 5 to 7 percent of actual copper are best for use on vegetable crops. Such dusts can be purchased from dealers in agricultural supplies.

Organic Fungicides

Certain organic chemicals of the dithiocarbamate group are often used in place of copper fungicides for control of a number of diseases of vegetable crops. These chemicals have been given the coined names of zineb, ziram, ferbam, and nabam. Commercial preparations of these materials can be purchased from dealers in agricultural supplies under various trade names, some of which are given below. Preparations containing any of these four compounds should be used as directed by the manufacturer on the package.

Common name	*Trade names*
Zineb	Dithane Z–78, Dry Parzate Fungicide
Ziram	Zerlate, Karbam White
Ferbam	Fermate, Karbam Black, Ferradow
Nabam	Dithane D–14, Liquid Parzate Fungicide

Sprays.—When used as sprays, the dry commercial preparations of zineb, ziram, or ferbam are mixed with water and nothing else is added. Nabam, a liquid, is added to water and then zinc sulfate and hydrated lime are added.

Dusts.—When prepared for use as dusts, zineb, ziram, and ferbam are mixed with talc or some other light, inert ingredient to make a dust containing 8 to 10 percent of the fungicidal chemical.

Sulfur

Sulfur dusts especially prepared for use on plants may be used for the control of powdery mildew of beans and sometimes bean rust. They are also of value in controlling some insects. *They should not be used on cucumbers or melons, as they are very damaging to these crops. For the treatment of a disease, sulfur should not be used unless it is recommended for this purpose.* Most vegetable diseases are best controlled by copper or organic fungicides.

Tables of Measures

The following tables of measures will be found convenient in preparing small quantities of insecticides for the garden:

Liquid measure:

3 *teaspoonfuls*=1 tablespoonful.
2 tablespoonfuls=1 fluid ounce.
16 tablespoonfuls
or
8 fluid ounces=1 cup.
2 cups=1 pint.
2 pints=1 quart.
4 quarts=1 gallon.

Approximate quantities required to weigh 1 ounce:

1 ounce of calcium arsenate	5 level tablespoonfuls.
1 ounce of chlordane wettable powder.	3 level tablespoonfuls.
1 ounce of copper sulfate powder.	5 level *teaspoonfuls.*
1 ounce of corrosive sublimate powder.	1 level tablespoonful.
1 ounce of cryolite	8 level *teaspoonfuls.*
1 ounce of DDT wettable powder.	6 level tablespoonfuls.
1 ounce of hydrated lime	3 level tablespoonfuls.
1 ounce of nicotine sulfate	5 *teaspoonfuls.*
1 ounce of paris green	1½ level tablespoonfuls.
1 ounce of pyrethrum flowers or powder.	5 level tablespoonfuls.
1 ounce of sulfur (dusting sulfur).	2½ level tablespoonfuls.
1 ounce of talc	3 level tablespoonfuls.

Quantity of Sprays or Dusts to Apply

Sprays.—For small gardens, approximately 1 to 1½ quarts of liquid spray is required per 50 feet of row for each application to plants of medium size.

Dusts.—For small gardens, approximately 1 to 1½ ounces of dust mixture is required per 50 feet of row for each application to plants of medium size.

Spraying and Dusting Equipment

The effectiveness of an insecticide or fungicide depends to a large extent upon the thoroughness of the application of the material. The most effective way of applying an insecticide or fungicide is by the use of either sprayers or dusters manufactured expressly for the purpose.

Sprayers

Hand Atomizers (fig. 1).—The hand atomizer is probably the most familiar type of equipment used in applying liquid insecticides, as it has been commonly used for applying fly sprays in the home. Its capacity is from ½ pint to 2 quarts and it is useful for spraying small plantings, although the under sides of the leaves of the plant are difficult to reach.

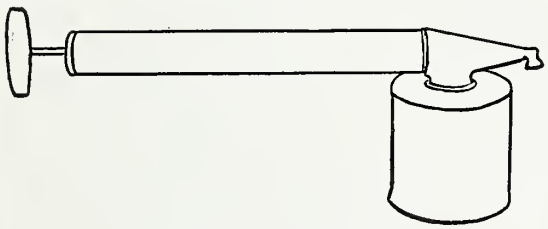


FIGURE 1.—Hand atomizer.

Compressed-air sprayers (fig. 2).—The compressed-air sprayer is the most satisfactory for the small garden, but its manufacture has been limited because of the shortage of metal. It is usually made of galvanized sheet steel and has a capacity of 1 to 5 gallons. Since these sprayers are not equipped with an agitator, it is necessary to keep the materials well mixed by shaking the tank frequently during the spraying operations.

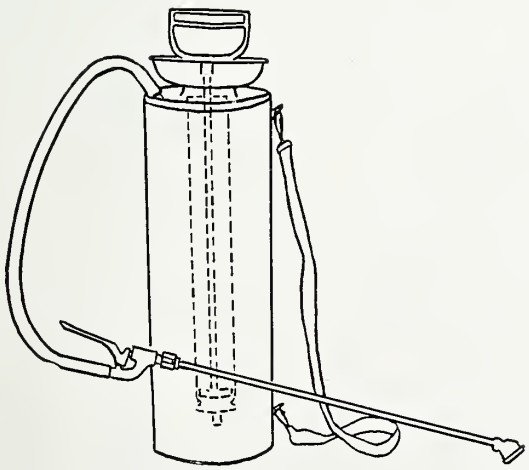


FIGURE 2.—Compressed-air sprayer.

Knapsack sprayers (fig. 3).—A knapsack sprayer is also a very useful piece of equipment for the home gardener. It costs more than the compressed-air sprayer but has an advantage over the compressed-air sprayer in that a higher and more uniform pressure can be maintained when the pump is kept in operation. An agitator is provided within the tank and operates with the movement of the pump handle.

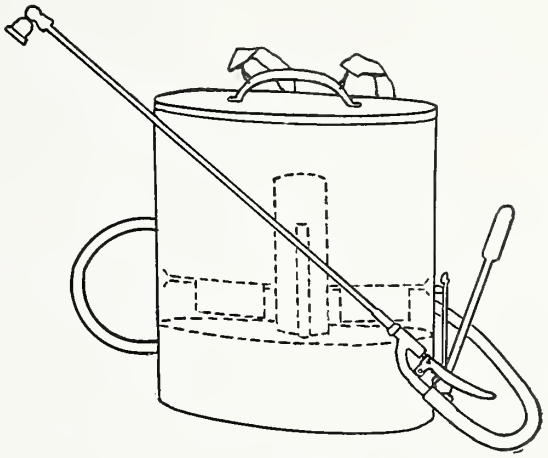


FIGURE 3.—Knapsack sprayer.

Bucket pump (fig. 4).—The bucket pump, or stirrup pump, was standard spray equipment prior to the war. The stirrup pump which has been manufactured and sold during the war period for fire-fighting purposes is not suitable for applying insecticides or fungicides without considerable modification as to nozzle and air chamber. It is necessary to have an air chamber in order to build up sufficient pressure, and a nozzle with a small opening to permit the spray to be applied in a fine mist. The most efficient operation of the bucket pump requires two persons—one to operate the pump and the other to manipulate the hose and nozzle.

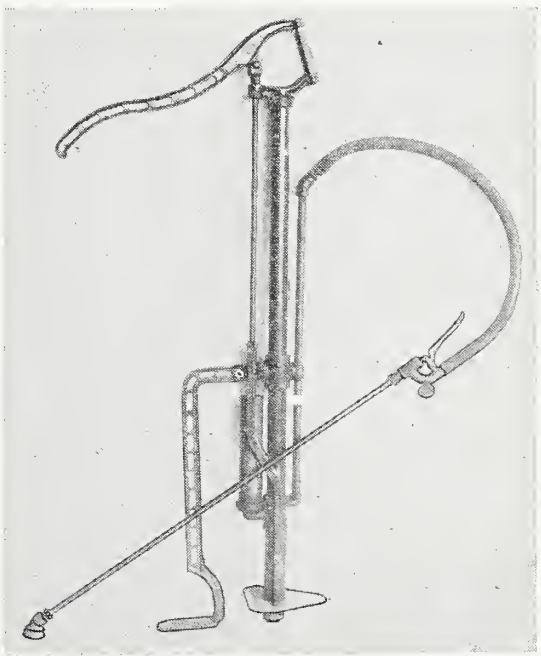


FIGURE 4.—Bucket pump with hose, extension rod, cut-off, and nozzle.

Dusters

Plunger type of duster.—The plunger type of duster (fig. 5), or dust gun, is the one most commonly manufactured for applying insecticides to small areas. Its dust-holding capacity ranges from 1 to 3 pounds. Prior to the war these dust guns were mostly of metal and equipped with metal or glass containers for the insecticide. The newer types placed on the market are made of wood and especially prepared paper. They are usually equipped with a tube and with a nozzle attachment that permits the dust to be directed to the under surface of the leaves.

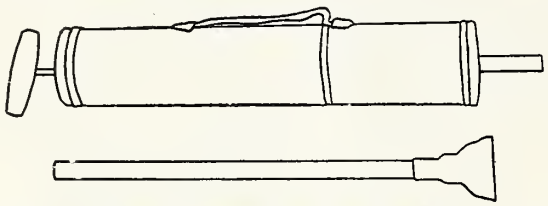


FIGURE 5.—Plunger type of hand duster.

Bellows type of duster.—Two types of bellows dusters are on the market. The smaller type (fig. 6) is made like the fireplace or blacksmith bellows, is equipped with special openings and a container for the dust or powder, and is satisfactory for small areas. The other type is the knapsack duster (fig. 7), which is satisfactory for applying insecticidal dust to both small and large gardens.

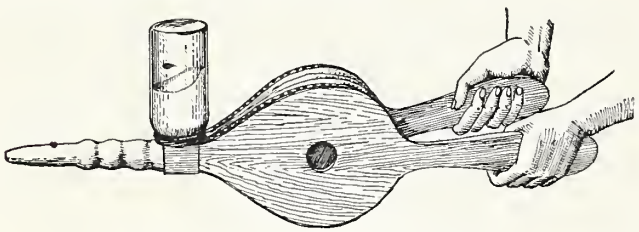


FIGURE 6.—Simple bellows type of duster.

FIGURE 9.—An ordinary medicine dropper used to inject oil among corn silks for earworm control.

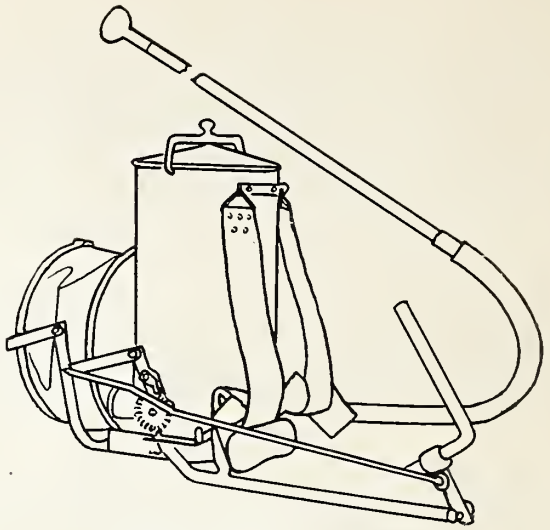


FIGURE 7.—Knapsack-bellows duster.

Fan or blower type of duster.—The fan or blower type of duster (fig. 8) is a satisfactory piece of equipment for both small and large areas. The knapsack-bellows and fan types of dusters are priced much higher than the small plunger and fireplace bellows types, but from the standpoint of efficiency of application and long-time service they are a good investment.

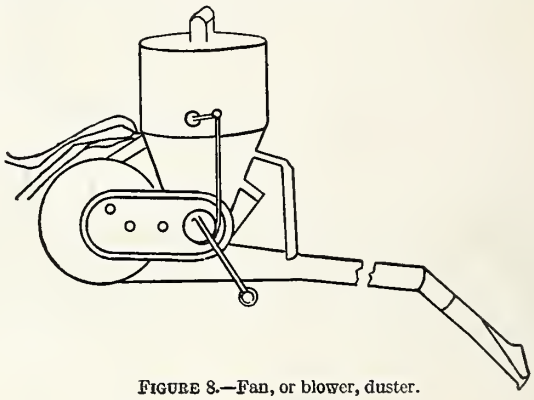


FIGURE 8.—Fan, or blower, duster.

FIGURE 10.—Protective devices: Left, a collar of cardboard will keep cutworms away from plants. Right, a tar paper disk placed around the base of each cabbage plant will aid in maggot control.

U. S. GOVERNMENT PRINTING OFFICE: 1951